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THE POTATO MOTH.

(Lita Solanella, Boisd.)

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In this little moth the potato-grower of many countries has in all probability his very worst insect enemy, not excepting, perhaps, the Colorado beetle itself. The perfect insect is a small, narrow, brown and grey moth, about seven lines across the wings when expanded (see Fig. 1A). The larva is of a pinkish colour, the size being slightly smaller than represented in Fig. 5. Although there exists much difference of opinion as to how the tubers of the potato are first attacked, I must agree entirely with M. Ragouet, of Paris (as quoted by Mr. Meyrick), that "the eggs are laid on the young shoots of the plant; that the larvæ, as soon as hatched, eat into the root stock, and descend until they reach a tuber; and that they remain in this, eating galleries completely through its substance, during the remainder of their larval existence." The larvæ, Mr. Meyrick goes on to say, pupate within their galleries, which they close with silk. These descriptions agree entirely with the results of my own observations and those of practical growers, who have taken the trouble to work the matter out for themselves. Mr. O. Tepper, of Adelaide, a good observer, and an old friend, gives it as his opinion that the female moth deposits her eggs in the stem, just above the ground, thereby bearing out in all the more important details the observations of M. Ragouet, alluded to above.

It has been stated that the insect is not in the potato while the latter is in the ground, and from these remarks we may reasonably infer that the moth is supposed to also deposit her eggs on the potato after being dug. This may or may not be the case, but it is not at all improbable that while in the pit, if exposed, the moths may deposit eggs in the eyes of the tubers, and that the young grubs, when hatched, would at once be able to eat their way into the potato. One thing seems perfectly clear, viz., that it is an almost impossible task for such a minute and fragile moth to descend into the earth, more especially when we find that the damage done is often greater in hard but rich potato land than when the crop is grown on poorer and more sandy soil. Of course, where fissures

occur in the soil, the moth might easily descend below ground. Again, I have received the haulms or stalks of the potato which have been tunnelled by some caterpillar from a foot above ground right down into the tuber.

Some years ago several settlers in the rich Brandy Creek district of South Gippsland sent me samples of potatoes that had been attacked by the caterpillar of this moth, and from which Fig. 4 was taken. This tuber had been cut through in about equal parts, each part containing no less than sixteen and thirteen larvæ respectively. These people complained more of the potatoes having been destroyed while in the pit or raised mound—a fact that could easily be accounted for by finding many of the tubers swarming with grubs, and from which in due time the little moths would appear.

Mr. R. Lucas, of Ensay, an old farmer, and a very keen observer, is quite positive about the eggs being deposited on the stalk of the potato; in fact, he goes so far as to say that he has seen the moth thus deposit her eggs. I have not been so fortunate as this, but I have found the grub in the stalk, and as it was working downwards only, it must necessarily have come from above; at least, such are the conclusions at which I have arrived after a careful consideration of the facts.

DESCRIPTION OF PLATE.

Fig.
1.—Moth. Magnified.
1A.—Moth. Natural size.
2.—Pupa. Magnified.
3.—Head and first three segments of larva upper side. Magnified.
3A.—Head and first three segments of larva under side. Magnified.
4.—Potato sliced to show effects of attack by larvæ of moth. Natural size.
5.—Larva. Slightly enlarged.
6.—Fore-leg. Moth.
7.—Hind-leg. Moth.

In dealing with a pest of this kind, we must at once admit the great value of a thoroughly exhaustive study of matters connected with life-histories of insects, and this can only be done by those having time or being on the spot. It is here, therefore, we see more than anywhere the great value of "Field Agents"—entomologists whose duties lie exclusively in visiting infested districts, and who endeavour by every means in their power to fully investigate and report on facts connected with the life-history, parasites, &c., of any particular pest that may make its appearance. Such institutions practically exist in America only, where they have means, population, and resources to carry on what is really a most necessary and useful, although sometimes costly, series of observations. How much can be done in this direction has been amply proved by the visit to Australia of my friend and fellow-worker, Mr. A. Koebele, whose valuable services have been recognized by the growers of the United States, over whose Entomological Department, Dr. L. O. Howard, so ably and admirably presides.

The history of the cottony-cushion scale in America, the damage caused by its ravages, and the introduction of its natural enemy, the Australian ladybird (*Novius cardinalis*), are now matters of history, and furnish one of the many practical illustrations of the value of an Entomological Department in any country where fruit-growing plays an important part in the every-day life of a portion of its people.

But to return to the potato moth and its habits. It may again be stated that the greatest importance is attached to any discovery that can shed additional light upon the life-history of this most serious pest. The

damage done to our potato crops in Victoria alone is almost beyond calculation; but knowing now fairly well where and how the eggs are deposited, should be of great assistance to growers and others when devising means for its destruction, more especially whilst the insect is in its earlier stages.

According to Boisduval, as quoted by Meyrick, and alluded to by Tryon, in certain districts of Algiers, during a single season, three-fourths of the potato crop was destroyed by this pest, and Mr. Tepper, of Adelaide, says:—"As far as my continued observation goes, the insect causes now, in its immature form of the caterpillar or grub, the destruction of hundreds of tons of potatoes every year by boring them, and thereby inducing putridity." Again, that these moths occur in other situations less confined than the entomologist's hatching case, was gleaned latterly from the information a farmer gave to me when speaking on the subject. He said that "he had several bags of potatoes, of his own production and quite healthy when dug, placed in his store-room, where they were left undisturbed for a considerable time. When he at last came to open a bag for use, quite a swarm of little moths greeted the event, and, to his surprise, he found the tubers spoiled by the grubs to a great extent." So far as can be ascertained, there is no record of the natural home of this pest; but Mr. Meyrick remarks:—"It does not seem to have been noticed in the home of the potato (America), and it is therefore, perhaps, more likely that it feeds naturally on some species of *Solanum* in the inland regions of Africa, and has spread thence on a congenial food plant being brought to meet it."

We have thus seen how much opinions differ as to the mode of attack practised by these moths, and Mr. T. Searle, in replying to questions as quoted by Mr. Tryon, states:—"I am perfectly sure that the insect is not in the potato while this is in the ground. We are almost daily using potatoes which were all dug up at one time, immediately picked up, and placed in a dry-goods cask, in which straw was placed between each layer of tubers. The cask is covered up by a corn bag, and, with the exception of a few near the top of it, none are affected by the moth." In Tasmania it was "invariably found that the moth attacks the roots. The uppermost potatoes—those that are nearest the surface—are, of course, more easily reached; nor is it by any means a difficult matter for the insects to penetrate to a depth of 3 or 4 inches where the soil is open, uncompressed, or lumpy. Not a single case of an infested stalk has yet been detected, but constant and numberless have been the instances in which, when uncovering the potatoes at the depths just indicated, moths have been dislodged, and have flown away uninjured." It has thus been, we may say, fairly shown that there still exists some doubt which ought, in the interests of growers, to be cleared up as soon as possible, as to whether the depositing of the eggs is confined to the stalks of the potato, or whether the tuber is also attacked while below or above ground, as a correct knowledge of these facts, which have been attested to by so many good observers, would be of the greatest value in helping us to devise some speedy and direct method of attacking the enemy in its earlier stages, and thus prevent the egg-laying.

In Queensland, as reported some time ago by Mr. Tryon, this moth has also been found attacking the tobacco plant. We must, therefore, be on the look-out, as tobacco plantations in Victoria may also be in danger of a similar visitation.

PREVENTION AND REMEDIES.

In the first place, we must try to get rid of the moths themselves, and to accomplish this we should use the knowledge already possessed. As we are certain of this insect being a night-flyer, the first plan that suggests itself is undoubtedly that of some cheap and effective lamp. In this connexion I may mention a letter which I received from Mr. R. Lucas, who says:—"My plan is simple, homely, and at hand at all times, without the cost of a shilling. All that is wanted is a common tin soup-plate, a clay wick-holder in which to burn fat, and a short wick an inch in diameter made of any cotton stuff. The wick-holder should not be higher than the rim of the plate, and be made to stand in the plate in its four lower corners, to enable the fat to gain access to the wick. The fat is best made hot at the first lighting of the lamp; the burning wick heats the clay wick-holder and keeps the fat in a liquid state. The moths fly to the light, drop into the hot fat, and are destroyed. The lamps require lighting about dusk in the evening."

That these moths will be attracted by a light I have proved myself, so that I feel quite justified in quoting the experiences of Mr. Lucas, as above. Here we have a remedy that may be termed a preventive one, and is one that growers can, without any outlay worth mentioning, use for themselves, as, should it be found that the moths can descend into the soil, they will in most cases be able to as readily ascend. If the egg laying is confined to the stems and young shoots, as supposed by Mr. Tepper and many others of our best observers, the "lamp" plan will answer all the same, and probably better

The next point to be considered is, how to treat the tubers, supposing the grubs to have already got at them? This would appear to be a most difficult matter, and probably the best advice that can be given would be to keep your lands as clear from weeds and rubbish as possible. Use none but clean sets, which, to be on the safe side, might be planted at a greater depth than usual. Pay great attention to deep and careful earthing, and, after digging, get the tubers off the ground and bag them as soon as possible. When in the pit keep them well turned over, and be careful to destroy any badly-infested tuber, as from these the moths will hatch, only to commence their depredations in another place.

Lime, if judiciously used when the potatoes are in the pits, has a good effect. Seed potatoes should be carefully examined before planting out. After the crop has been dug, more especially on land where the moths are known to exist, if at all possible, a good dressing of gas-lime, at the rate of, say, 30 bushels per acre, would be of much benefit. This must, however, as advised by the late Chemist for Agriculture, Mr. A. N. Pearson, be exposed for some weeks to the air before using. Air-slaked lime, if well harrowed in before planting the sets, has been tried and found to be of very great use, and a change of soil has also its advantages.

Mr. Tepper suggests that the tubers, prior to storing, should be washed clean and bathed in some solution which might be distasteful to moths or their progeny, and mentions the use of weak salt or sulphuric acid solutions. Mr. Tryon, however, thinks that alum would be more suitable, and I am inclined to agree with him in this respect. It is feared, however, that in a country where potatoes are often sold at so low a figure, that the methods proposed by the gentlemen referred to, would be somewhat too expensive for general use. Still, for those tubers which

are intended for seed purposes, it might be carried out with advantage by those having facilities for doing so.

Most excellent results have been obtained by spraying both the tops and the tubers themselves with Paris Green (paste form)—1 lb. Paris Green, 6 lbs. lime, diluted with 200 gallons of water—but for spraying, the lands should be so arranged to admit of a horse sprayer being driven between them. The spraying should be done as soon as the young shoots have sufficiently ripened, and again at intervals as circumstances demand. A spraying before being pitted would also be of service. I have saved hundreds of acres of potatoes from other caterpillars by simply spraying the foliage twice during growth.

The slush-lamp system should have a good trial, and must be placed in a growing crop (Mr. Lucas thinks when in flower), also amongst the pits in which the tubers are usually stored. One drawback, however, to the use of the slush-lamp is, that large numbers of ichneumons, "lace-wings," and other useful insects are also attracted by the light, and, of course, killed.

In this age of wonderful discoveries it would not be too much to expect, or, at least, hope, that resistant kinds of potatoes may yet become general, in which case many of our troubles with these pests, at least, will be removed.

The failure, even if only partial, of our potato crops, is a serious matter for any community. In helping each other with advice, and the results of our experiences, we may be able to considerably reduce the damage done by this widespread and destructive little insect. We must have, in addition to our own experiences, the co-operation of the growers themselves.

The use of the tarred canvas frame would also be of great advantage, as immense numbers of moths of many kinds may be captured by its adoption. Take some light battens (soft wood is the lightest and best for the purpose), cut them into 5 ft. lengths, fasten together at the corners, and on this frame, to which should be attached a long handle, stretch some stout calico or light canvas, the latter being the more desirable. Smear the underside of the canvas with tar, which must be put on cold, and without having been heated. With this machine go through your growing crops, also amongst pits and bagged potatoes. If this canvas frame be judiciously used, a vast number of moths can be destroyed. This plan has been found to answer well in the case of the cabbage moth, but in treating for the latter the plants should first be struck with a bunch of twigs to cause the moths to rise. One trial of this plan will be sufficient to convince any reasonable person of its efficacy.

Before closing these remarks on this pest, it is advised, where at all practicable—and there really seems to be no insuperable obstacle to this being carried out—that the lands on which the potatoes are planted be so arranged that a machine, such as the Strawsonizer or the one invented by Mr. Pearson, could be used for the purpose of distributing tar or other cheap insecticides in a liquid form, such as before described. It is well known that tar in any form is particularly obnoxious to insects of most kinds, and by a timely application of such the moths may be prevented from depositing their eggs. If tobacco plants should be attacked, a light spraying of white hellebore, mixed in the proportion of about 1 lb. to 30 gallons of water, would be effectual in destroying the grubs. Any of the introduced *Solanæ*, such as the "Sodom apple,"

nightshade, and others, should be rooted up and destroyed by burning, these being not only breeding plants for many of the smaller moths, but, when the fruits are eaten, are most injurious to children, also to stock, and should never be allowed to grow within miles of either farms, orchards, vineyards, or gardens of any sort. The introduction of noxious, and often poisonous, weeds into these States has been a real calamity, as in several cases the advent of destructive insects may be traced to their agency.

POTATO EXPERIMENTS AT BUNYIP, 1905-6.

D. McAlpine, Vegetable Pathologist.

The experiments were continued from the previous season, and the main object was to test the effect of different treatments in the prevention of various diseases, especially that known as brown ring, which is very prevalent in some years in the variety known as Beauty of Hebron. The treatment consisted in the application of various substances to the seed, and spraying the plants when above ground. The substances used for the seed were corrosive sublimate, formalin, bluestone, sulphate of iron, and lime and sulphur mixed. All the "steeps" were applied to the potatoes before being cut, and the sets were allowed to dry before planting.

Owing to the dry season the brown ring did not appear either in the treated or untreated plots, but the experiments served to show the substances which might be safely used in anticipation of their being employed for other diseases. Thus a solution of formalin or corrosive sublimate is a well-known preventive for "scab," and the tubers were soaked for two hours before planting either in corrosive sublimate solution at the rate of 2½ ozs. in 15 gallons of water, or in formalin at the rate of 1 lb. in 30 gallons of water. A small quantity of "scabby" potatoes were planted, and it was found that the scab appeared in the produce, thus showing the necessity for planting tubers which are perfectly healthy, and free from disease.

The spray used was Bordeaux mixture, consisting of 4½ lbs. bluestone, 4 lbs. fresh lime, and 30 gallons of water. Poisoned Bordeaux mixture was also tried with Paris green added at the rate of about 1 oz. for every 10 gallons of water. Spraying has now become a regular and profitable practice with the orchardist, and in view of the possibility of the potato disease reaching us from New Zealand, it is well to know that this disease can be largely controlled by spraying the potato tops. And not only is Bordeaux mixture used for combating the majority of plant diseases due to fungi, but it has the further useful property of enabling the sprayed plants to retain their foliage for a longer period than they otherwise would. On this account the plant is able to extend the growing period, store up more material in the tubers, and thereby increase the yield. The gain due to the spray, as shown in these experiments, is far more than sufficient to repay the cost, and this fact should help the practice to be all the more readily adopted for the prevention of disease.

The accompanying table gives the total yield per acre, and the percentage of large potatoes obtained as a result of the various treatments. The planting was done during the first week of December, and the digging in the first week of May, being a little late owing to the dry season. The

average yield in the check plots was 2 tons 3½ cwt., and this will be the standard of comparison in judging the effects of the different treatments on the yield. The highest yield was 3 tons 8¾ cwt., from seed treated with bluestone powder, and afterwards spraying the plants with Bordeaux mixture. The lowest yield, and the only one below the check, was 2 tons 1½ cwt., from seed treated with corrosive sublimate, while formalin-treated seed yielded about 6 cwt. more. The sulphate of iron dip consisted of 1 lb. to 3 gallons of water, and whole sets were steeped for two hours, but none grew, and seed treated with this strength was evidently killed. Where sulphate of iron was used in the form of a powder, the seed grew all right, and yielded 2 tons 13¾ cwt. The spraying with Bordeaux mixture on 22nd February was very successful as regards yield. With untreated seed, but plants afterwards sprayed, the yield was 11¾ cwt. above the check, and where the seed was treated with bluestone powder, in addition to spraying, the gain was 1 ton 5¼ cwt. The increase from spraying was not only due to the extended period of growth, but from its checking the development of such diseases as early blight, which appeared in some of the untreated plots.

Plot.	Treatment.	Large.	Small.	Total.	Large	Total per acre.		
		lbs.	lbs.	lbs.	per cent.	ton	cwt.	qr.
1	Corrosive sublimate dip for seed ...	235	75	310	76	2	1	2
2	Formalin dip for seed	295	58	353	83	2	7	1
3	Check	223	63	286	78	1	18	1
4	Seed untreated—Bordeaux spray in February	347	66	413	84	2	15	1
5A	Bluestone powder sown with seed ...	170	62	232	73	3	2	0
5B	Bluestone powder sown with seed and sprayed	193	64	257	75	3	8	3
6	Check	280	84	364	77	2	8	3
7	Sulphate of iron dip for seed... ...	—	—	—	—	—		
8	Sulphate of iron powder sown with seed	314	87	401	78	2	13	3
9	Lime and sulphur powder sown with seed	246	88	334	74	2	4	3

NOTE.—Plots 5A and 5B are only half the size of the others.

FRUIT TREE MAKING.—WHAT TO PLANT.

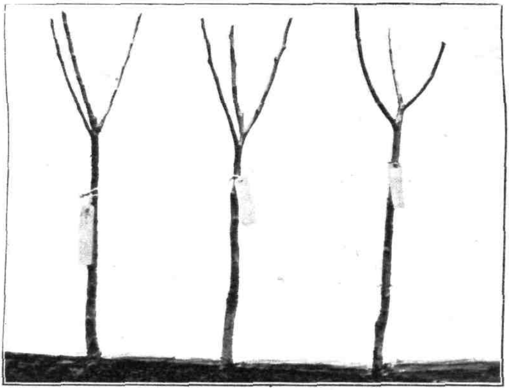
A. G. Campbell, Assistant, School of Horticulture, Burnley.

The success of an orchard, like that of a farm, after the site has been selected, must depend upon the quality of the material used to stock it This is a primary principle, and, therefore, of no small importance. Apart from variety, which may be according to the wish of the owner, or the requirements of the market, there is the vigour of the stock to be considered; and vigour and health are what stand at the back of all else that can be expected from any living things. Too often orchards, or parts of orchards in poor places, have failed simply because the trees were not vigorous enough to meet the demands made upon them by the situation. Whereas, had they been a degree or two more vigorous, they would have

been alive and profitable to-day. Youth is the critical time; if the rule is recognised and acted upon in connexion with farm animals, why not with fruit trees?

THE PUBLIC TASTE.

The making or marring of the orchards of the future lies in the nature of the young trees, which are turned out by tens of thousands annually from the nurseries in several parts of the State. The public demand is at present for a large tree to plant out, even three-year-olds being asked for in some instances. But it is a fact that the larger the tree the less kindly it takes to transplanting. It is not to be supposed that a tree that has made good its foothold into the soil, and has adapted itself



TYPE OF TREE ON THE MARKET TO-DAY.

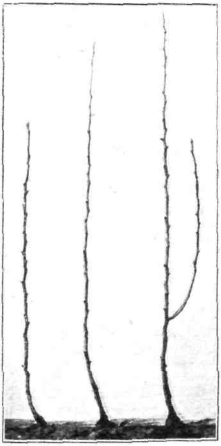
to the climatic conditions, will take so kindly to removal as one not in that condition. It has been proved that the yearling tree gives the best results. Further, in order to comply with the public demand, the growing stems of young trees are pinched in order to make them throw out second growth to form a large head. Though this head may be large in appearance, and seem "a lot for the money," it is not so in vigour and in quality. Shoots, which are forced as late as December, cannot be equal to those that take full six months to mature, and shoots of this "unripe" character can never form the basis of a sound head to the fruit tree.

Again, the headed tree is already formed as far as the trunk is concerned. The trunk can neither be lengthened nor shortened, and must remain at the eighteen inches or two feet allotted it in the nursery. It is folly to plant an orchard of mixed varieties on one length of trunk. Strong varieties may be too powerful, and weak varieties too sickly to fruit well if both are on a two-feet trunk. The trunk must be allotted according to the inherent nature of the tree; a Jonathan apple, for instance, on a one-foot stem, and a William's Bon Chretien pear on a three-feet stem, would

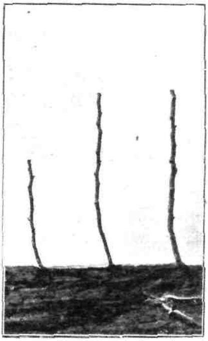
both, under similar treatment, give an equal profitable result. Any given variety of tree, also, if planted out of its natural climate, that is, to the north or to the south of conditions best suited to it, must have its trunk shortened in proportion; so the fruit-tree planter should aim at giving his transplanted trees as little check as possible, and he should also have it in his power to make the trunks of whatever length he deems necessary in his district.

THE KIND OF TREE TO PLANT.

The kind of tree suited to these requirements is undoubtedly the yearling whip, that is the season's clean growth from the bud (which should be near the ground), not interfered with in any way during growth. The growing of this whip entails absolutely no work in heading and trimming, and



Unpruned.



Pruned according to length of trunk required.

THE BEST TYPE OF FRUIT TREE TO PLANT.

so the cost of production is considerably reduced. Nature is allowed to produce the yearling tree in her own way, and no improvement on this can be imagined. There are other advantages which tell heavily in favour of both the nurseryman and the buyer. Besides being cheaper to rear, as well as stronger in constitution, these yearlings are, in the replanting season, very much easier to handle. They are compact in growth, and light in bulk, easy to pack, and cheap to carry.

There are, however, some difficulties to consider by the way. Many varieties will not throw clean whips in the nursery under the existing conditions of open planting for cultivation. They spurt laterally from a number of the buds. This is a sign of vigor to be welcomed in young trees. The apex of the shoot, growing upward as fast as possible, is

still not able to absorb all the sap sent up from the roots, so the surplus must break out in other parts. Strong shoots at the top of a young fruit tree often behave similarly, while those in more crowded parts remain as single whips. There are two ways of treating these growths. In most varieties they can be cut, in the pruning season, cleanly away, and there are round at their base one or two developed buds ready for growth in spring. Or, if these base buds are not present, the three best branchlets, about the height at which the trunk is to be cut, can be left and pruned to throw shoots for the permanent branches. In this latter case, the shoots thrown from these branchlets will be vastly superior in quality to those thrown from the pruned second growth of headed trees.

HOW TO OBTAIN THE BEST TREE.

If the intending planter waits until next winter before ordering his trees, he will find it impossible to obtain any large supply of yearling whips. All the nursery stock has been headed during the growing season, and only those too small and weak at the time when such treatment is given, are left to grow a single rod. Arrangement, however, can be made with some advanced nurseryman to let well alone, and for as many hundreds of such varieties as may be required, to be delivered next winter as straight whips four to six feet long, or if with side spurts so much the better. This agreement should be made now as the season of growth will soon be round.

CASTRATION OF FARM ANIMALS.

S. S. Cameron, M.R.C.V.S., Chief Veterinary Officer.

Colts are customarily castrated as yearlings; calves and lambs at any age up to a year, and pigs at four to six weeks. Amongst racers, horses are "added to the list of geldings" at almost any age, and occasionally stallions of other breeds are "cut" and bulls are made "stags" of at a later period of life. The operation is the same in all cases except that with aged horses in full condition a little extra care in providing for the arrest of bleeding is necessary, and for this reason, as also because of the liability of aged animals to fracture of bones, the "standing operation" is often preferred in such cases. The standing operation is safer for the animal, if not for the operator, and doubtless as time goes on this method will become customary when dealing with valuable or high-mettled animals of all ages.

It is advisable that the subjects should be kept without food for twelve hours or more before being operated on, and racehorses in training should be thrown out of work, and stallions in high condition reduced by soft diet for several days before. A further very necessary precaution prior to the operation is to handle the scrotum or purse while the animal is upright, so as to know that both testicles are "down," and that there is no rupture. When this precaution has been neglected, colts are occasionally lost through protrusion of the bowels after castration, and such losses are altogether inexcusable.

CASTRATION IN THE RECUMBENT POSITION.—The usual method of "throwing" for castration is with "side-lines," *i.e.*, a collar and heel ropes, made by forming a loop midway between the ends of a long rope, the loop being used as a collar and the ends of the rope passed round the hind pasterns, or, if chafing of the pasterns is to be avoided, the ropes are passed through rings in hobble straps, put on to the hind pasterns. The rope ends are then taken forward, passed under the rope collar at the shoulder, and then pulled on from the rear, when the colt, after a struggle or two will be thrown gently on his side, with the hind limbs drawn up towards the shoulder. An assistant should keep the head steady on the ground, while the two hind limbs are secured with a couple of half-hitches of the heel rope. The uppermost fore limbs may also be secured with the same rope, or with a strap.

Before operating, it is customary to take this opportunity to remove any accumulated wax from the sheath, and to wash it, and also the penis with soap and water, or with an antiseptic solution—say, one table-spoonful of lysol or creolin to a gallon of water. The skin of the scrotum and inner aspect of the thighs should also be similarly washed, and the operator's hands and instruments should be scrupulously clean—made sterile, in fact, by washing in hot water and washing soda or other disinfectant solution.

The testicles are usually odd in size, and it is advisable to incise for the smaller one first, for it is often drawn up and difficult to find after the larger one has been let out. The testicle to be excised should be grasped between the finger and thumb of the left hand from the front, and the skin of the scrotum covering it made tense. With the castrating knife in the right hand, a bold incision is made in the direction of the long axis of the testicle, just sufficiently deep to cut through the skin and testicular coverings, and expose the testicle but not wound it. The incision should be made sufficiently long to allow the testicle to slip out without difficulty; not that the squeezing of the testicle through a small opening is untoward, but in order that, afterwards, free drainage of discharges from the wound may be provided. If the wound made is a small one, the edges are inclined to curl up and cause a "pocketing" of blood and discharges, and, in the majority of instances, it is the retention of discharges so caused which promotes the after-swelling of the scrotum and sheath frequently associated with castration.

The testicle having been extruded, the next step in the operation may be carried out in a variety of ways—but it is always advisable to get both testicles out, and cut the muscular or white portion of the spermatic cord before proceeding.

(1) *Searing.*—In the old days, before the use of antiseptics became the vogue, searing was the almost universal practice, and it is still as safe and satisfactory as any other method. It has been superseded, not on account of its non-success, but because the carrying of the necessary searing irons and clams, and the necessity of a fire, made it somewhat cumbersome, and perhaps also because the new chum at the game is apt to favor, for effect, something "flash" or uncommon in the way of instruments. That success attends new methods of castrating is not due to their superiority, but to the simplicity and safety of the operation by whatever method performed.

In removal by searing, the spermatic cord is gripped about an inch from its junction with the testicle (at the *epidydimus*) by a pair of steel or wooden castrating clams, and the searing iron is then applied at a dull

red heat until the cord is severed. Sometimes, in the case of animals in vigorous condition with a full artery, a silk ligature may be put on the artery before it is seared. On severance, the hot iron is applied to the arterial portion of the cord until a good brown sear or seal is made, then the clams are loosened, and the seared end of the cord allowed to gently slip back, that is, if no bleeding from the sear is noticed. If a jet of blood is seen, the clams should be quickly closed, and the searing repeated until an effective seal is obtained.

(2) *Caustic Clams.*—This is also an old method—successful also, but inconvenient in that it necessitates a second visit for the removal of the clams on the following day. The clams are of wood, and contain grooves on their opposing surfaces, which are filled with arsenic paste or other caustic. They are applied tightly, and fixed one to each cord just above the testicle, which is then cut away. The clams are allowed to remain on for 24 hours, during which time the caustic has effectually destroyed and blocked the artery.

(3) *Torsion.*—In addition to the steel clams, a special pair of forceps is used for castration by torsion. These forceps are a kind of glorified pair of pincers, with flattened and roughened claws, with which the cord is grasped and twisted until it is severed. By this means, the coats of the artery are stretched or torn asunder, and by their elasticity they curl in and efficiently block the torn end of the artery so that a clot is quickly formed and bleeding arrested. It should be observed that there is no bleeding from the end of the cord before allowing it to slip back on loosening the clams.

(4) *The Ecraseur* (French for "crusher.")—This is an instrument provied with a slot through which the loop of a chain, constructed like a bicycle chain, passes. The chain loop is passed over the testicle on to the cord, and is gradually tightened by the action of a screw handle, so that the cord is compressed and ultimately severed by being torn through. The artery becomes sealed in the process, as when it is severed by torsion, and there is little bleeding from it; but the process is somewhat slow, and on that account mainly has not come into that general use which its safety and neatness warrants.

(5) *Castrating Forceps (various).*—Many kinds of castrating instruments have been invented from time to time. They are mostly of two types, of which the "Reliance Castrator" and "Kendall's Emasculator" may be taken as examples.

The "Reliance Castrator" has a scissors-like action; one leg of the scissors is curved, and has a double blade, forming a slot, into which the other blade (single) fits, on the instrument being closed. Both blades have serrated edges, and when the cord is placed between them, and their closure commenced, the tissues (including the artery) are forced by the single blade into the slot between the blades of the double leg, and severance is brought about by compression within the slot and by the scissors-like action of the serrated edges. Slowness is required in manipulation, otherwise the artery is more likely to be cut than torn through, and the sealing is then not effective.

The "Emasculator," invented by Mr. W. T. Kendall, M.R.C.V.S., Principal of the Melbourne Veterinary College, is an instrument designed to simulate the action of the teeth in biting, and it is perhaps the safest and most practical castration instrument that has yet been introduced. It resembles a farrier's pincers, with the face of the claws broadened to about

3 inches; one claw has two blades, forming a slot, about an inch deep, and into which the single blade of the other claw fits on closure. All the blades have dentated or tooth-like edges, but the special feature is that the single blade first contracts the slot on its under surface, and when it is pushed home on its upper surface. Thus when the cord is compressed by the blades it is dragged into the slot and the tearing or biting pressure is spread over about an inch of the cord. The severance is therefore brought about by an inch-long crushing or laceration of the cord, instead of by a cutting or tearing at one spot. In using this instrument, the cord should be gripped by the claws, which should then be closed firmly and slowly. The testicle may then either be pulled off or cut off at the back of blades, and the crushed end of the cord liberated by opening the blades gently.

On completion of this part of the operation, all blood should be washed off with the antiseptic solution, and the scrotum and inner aspect of the thighs anointed with a dressing of lysol or creolin and linseed oil (1 to 100). This for the double purpose of deterring flies and preventing excoriation of the skin by discharges from the wound during the healing process.

CASTRATION IN THE STANDING POSITION.—In the absence of a trevis, or narrow crush pen, the animal is best fixed for this operation by roping him close alongside a post and rail fence—his off-side to the fence, in such fashion as to prevent him moving outwards. For the safety of the operator, a twitch should be used, and a side line put on to prevent undue freedom of the near hind limb. The operator needs to stand close up to the near hind, pass the left arm in front of the stifle, and grasp the testicles with the left hand from the front, so as to tense the skin. With the knife in the right hand round the back of the thigh, a rapid cut from before backwards is made through the skin lengthways of the testicle—first one and then the other. The knife blade should be held so as to guard the depth of the cut, and if the incisions are made smartly and dexterously the horse will do no more than flinch. Flinching at this time is allowable for the horse, but not for the operator. So effective is the first smart cut in cowering the horse that he seldom gives any trouble afterwards, and some operators, when dealing with colts, never bother to fasten them at all. For the severance of the cord in the standing operation, either the "Ecraseur" or Kendall's "Emasculator" may be used, but the former is perhaps preferable, as it can be easily worked by an assistant from behind while the operator holds the chain loop in position on the cord; or, the caustic clams may be affixed and the testicles removed with the knife.

UNTOWARD RESULTS OF CASTRATION.

HÆMORRHAGE.—Slight hæmorrhage always occurs after the animal rises from the operation, the bleeding being from the vessels of the skin and cord—not necessarily from the spermatic artery. If the flow is from the latter, it will stream down the inside of the limbs, and in such cases it is necessary to insert a full plug of carbolized tow or cotton wool, so as to favour the formation of a clot on the end of the bleeding vessel. The plug may be removed the following day. If plugging fails, the artery will have to be ligatured, and to do this the horse will have to be cast again, and the artery searched for and picked up with a pair of artery forceps.

AFTER-SWELLING.—Except this is excessive, no notice need be taken of it, except to limit the diet and allow the animal to take gentle exercise in a small paddock. In some cases, it will be advisable to make patent the wound openings in the scrotum with the fingers, and so dis-imprison the collected discharges, and it may be necessary to enlarge the openings. If the swelling spreads forward to the chest, and is inconveniently excessive, a puncture or two here and there with a clean blade will allow fluid to drain away, and relieve the swelling considerably.

SEPTIC PERITONITIS, or TETANUS (Lock-jaw), may supervene in from three to fifteen days, when, through the use of unclean instruments, the germs of these diseases have gained access to the wound, but the risk is not great, as the usual bleeding has a salutary effect in flushing the wound free of foreign matter. (For tetanus inoculation during castration, see later articles.)

RUPTURE (Scrotal Hernia) has been previously referred to. On the occurrence of such an accident the only course is to speedily throw the animal, swab the protruding portion of bowel with a non-irritant antiseptic, and push it back as gently as possible. The wound must be securely stitched, and the horse kept in the recumbent position as much as possible. A fatal termination can, however, be scarcely avoided.

CASTRATION OF OTHER ANIMALS.

The same general directions as for castration of horses may be applied to the operation on other animals. In the case of bulls and lambs, the manner of opening the scrotum is sometimes varied. The end or tip of the purse is grasped and stretched, and a piece is cut off bodily by a cross section, so allowing the testicles to be easily extruded. When this is done, the skin of the scrotum curls upwards and inwards, and shrivels considerably during the healing process, and a bullock so gelded never shows or "handles" the same amount of "cod" as one in which the longitudinal incisions have been made.

CASTRATION OF RUPTURED HORSES.

SCROTAL HERNIA—that is, a rupture—in which a portion of the bowel has passed through the abdominal wall at the inguinal ring, and descended into the scrotum, renders castration in the ordinary way impossible; and what is known as the "covered operation" is substituted. This, as originally practised, is a tedious operation, and is the subject of elaborate explanation and direction in text books on operative veterinary surgery. But the method introduced by Williams is far simpler and equally safe. Williams' operation is simply castration with the caustic clams, without opening the scrotum. The bowel is pushed out of the scrotal sac while the animal is on its back, and the scrotum and its contents—the testicles—are included in a pair of strong caustic clams applied tightly above the testicles and as close as possible to the belly. The clams may remain affixed until the testicles and scrotum slough off; or, the testicles may be removed with the knife below the clam the following day, and the clams allowed to remain in position until they drop off. If Möller's plan of cutting through the skin before affixing the clams is followed, great care must be taken that the *tunica vaginalis* (or inner skin covering the testicle) is not incised.

THE ELEMENTS OF ANIMAL PHYSIOLOGY.

W. A. Osborne, M.B., D.Sc., Professor of Physiology and Histology, Dean of the Faculty of Agriculture in the University of Melbourne.

(continued from page 458.)

CHAPTER II.

Mammalian Tissues.

The lowest form of life is, as has been stated, the single-celled plant or animal. The bioplasm of such a cell carries out manifold functions; at its surface food for fuel and repair is absorbed and waste products are excreted; it prepares ferments and chemical antidotes against certain poisons as we shall see later; it is contractile and can propagate the disturbance caused

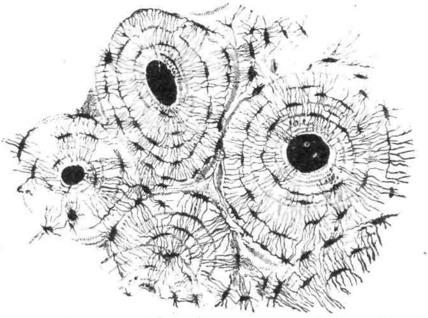


Fig. 10.—Bone showing the tube systems cut across; the bone cells with their prolongations (coloured black) lie between the tubes. The space in the centre of each system contains blood vessels and nerves. (After Sharpey.)

by a stimulus; it can also store food to some slight extent. The animals and plants next in order to these single-celled beings are those which may be looked on as colonies or communities of cells. But in such a colony there is a certain specialization of labour; one set of cells, for instance, may be concerned chiefly with the capture of food, and may allow the other qualities of its units to remain in a backward condition. Another set may have chiefly to do with the locomotion of the entire colony. As we proceed upwards in the scale of life, and especially is this the case with animals, we find that the collections of cells become larger and more differentiated and each set of cells more dependent on all the other sets, so that its units die if cut away from the main mass. When in such a collection of cells we find that the reproductive function is specialized, when from one cell (egg or spore) there can arise not only reproductive cells but cells representing all the various sets present in the complex, then we can no longer regard this complex as a mere community—it has become a single individual.

As we proceed upwards in the evolutionary scale we find then that new groups of cells are marked off from their fellows to carry out some function, and that the other cells of the animal body are relieved of this

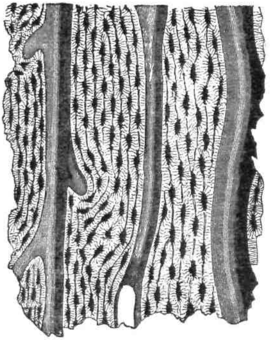


Fig. 11.—Bone showing the tube systems cut longitudinally. (After Rollett.)

function. This division of labour makes greater efficiency possible, for the whole time and material present in each cell can be applied to the performance, not of many duties, but of one only or, at least, a few. Thus we

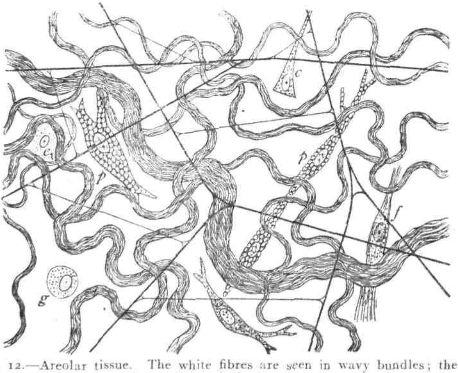


Fig. 12.—Areolar tissue. The white fibres are seen in wavy bundles; the elastic fibres form an open network. (After Schäfer.)

find in muscle a number of cells so altered that contractility is the chief or only function which they retain, whilst other powers have been suppressed. Each muscle cell can contract, and contract more forcibly than

any single-celled organism, but only when waste material is removed, when it is shielded from injury, when it is kept at the proper temperature and washed with a solution of the proper concentration and chemical composition—and all by the labour of other cells, which, in their turn, are arranged in groups, each group carrying out some single or simple set of functions, and all of them forfeiting the power of contractility.

Such a division of labour finds a parallel but by no means so perfect in communities of men. The higher the civilization the greater is the specialization of duty, and the more dependent is one group on another. We can see at the present day that the tendency is for men not only to apply themselves to one trade or profession, but to specialize in it, whilst other parts of the same calling are specialized in by other men, and all the time the other necessities of life are being attended to by other groups of

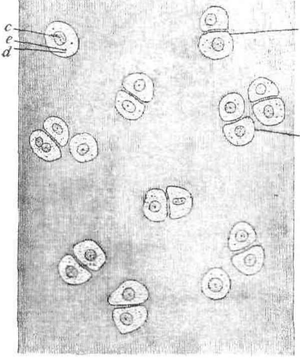


Fig. 13.—Ordinary cartilage. (After Schäfer.)

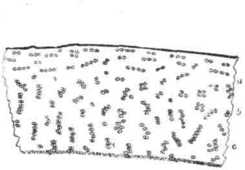


Fig. 14.—Cartilage at the end of bone eatering into a joint.

specialists. Now just as this tendency to specialize is regarded as an essential and a proof of advancing civilization among men, the same tendency to specialize amongst cells of the animal body has meant advancing organization of the body or evolution.

Every animal starts life as a single cell (fertilized egg). The cel divides into two, and each daughter cell divides and subdivides repeatedly Even at an early stage of development the cells display a differentiatio into two or three groups. As growth and cell multiplication continue more and more differentiation is discernible until, in the mature animal the differentiation reaches its limit for that particular species to which th individual belongs. The structures, therefore, which are found in th animal body may be classified according to the type of cell of whic they are composed—in other words, may be classified into TISSUES.

Connective Tissues.

The cells in a particular group, relegated to a particular function, could not act properly unless supported and held in position. Moreover, each group must retain its proper place and not be liable to any great alteration in position or shape. We find then that between cell and cell there is always a cementing substance or INTERCELLULAR SUBSTANCE even when the cells are apparently in close contact. This intercellular substance, though outside the cells, has been derived originally from cells. But such a union is not sufficient for the body's needs, and thus it comes about that certain tissues are set aside to act in a purely physical manner, to support and bind the cells of active tissues together, to hold organs in position, and to give rigidity and elasticity where such is required. Such tissues are connective tissues, and in them we find that the intercellular substance is often in great excess of the cell proper though dependent on the latter, for, if separated from its cell, it undergoes degenerative changes. The cells in connective tissues have no special function to perform, except to nourish and to maintain the physical condition of the tissues; their activities therefore are small.

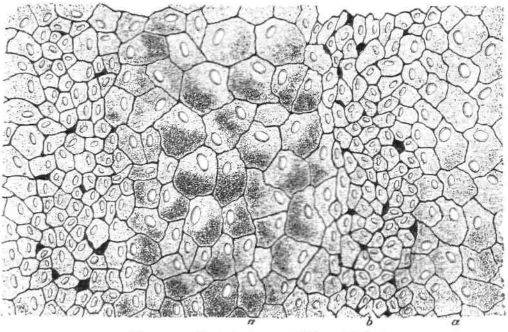


Fig. 15.—Endothelium. (After Klein.)

In FIBROUS TISSUE such as we find in tendon (sinew), the intercellular substance is composed of fine fibres which, though readily bent, are extremely tenacious and almost unstretchable. If the fibres are densely interwoven and spread out to form a flat membrane such a tissue can act as an envelope or tough capsule, as in the eyeball, testis, &c. In BONE we find fibrous sheets, some forming a series of tubes one inside the other, some running from one set of tubes to another, and each bolted to its neighbour by fibrous pegs like layers in the sole of a boot. Even this dense and well riveted tissue is not rigid enough for the body's needs, and so mineral salts, such as calcium and magnesium phosphates, are precipitated through and through the fibrous sheets.

The DENTINE or ivory of teeth is composed of very minute tubes of fibrous tissue which lead from the tooth pulp to the inner side of the enamel, and, like bone, are hardened by deposition of mineral salts.

In ELASTIC TISSUE the fibres have a different chemical constitution which confers on them very different properties—they are highly elastic in the sense that indiarubber is elastic and, in consequence, this tissue is found in parts where frequent stretching is necessary without producing a permanent change. All the larger quadrupeds have a strong band of elastic tissue (*ligamentum nuchae*) running from the head along the back

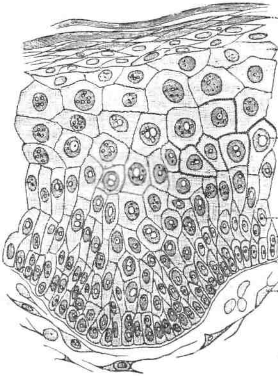


Fig. 16.—Section of skin. (After Cadiat.)

of the neck and firmly joined to the spine. This ligament saves the animal a great amount of muscular exertion by helping to keep the head up or to raise it when lowered. Elastic tissue is also found in the arteries which are subjected to varying pressures of the blood within.

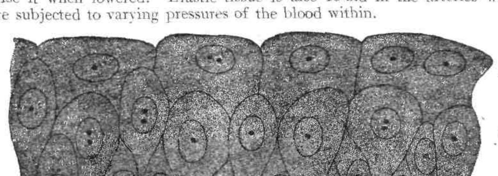


Fig. 17.—Section of the lining of the bladder. (After Schäfer.)

When the intercellular substance is composed of a very loose network of fine fibres, some elastic and some fibrous, the tissue is called AREOLAR. Areolar tissue is admirably adapted for holding in its meshes the active cells of other tissues; it enters into every muscle and nerve, supporting the cells and collecting them into bundles. It also enters into every gland, binding the lobes of the gland together.

CARTILAGE, or gristle, is really a form of fibrous tissue, though in some forms the fibres have lost so much of their distinctiveness that the intercellular substance looks transparent and glassy. In a few parts of the body, as in the pads between the bones of the spine, fibres are present, and are elastic. In all forms of cartilage the cells are fairly numerous, and fibres, when they can be seen, have only a short course. Cartilage functions as a pad with a smooth surface on the ends of bones when these take part in forming a joint; it is also of use where some rigidity is required, but where a certain amount of flexibility must also be retained. Thus the ribs are joined to the breast bone by cartilage, the external ear and the nostrils retain their shape by it, and the windpipe is kept open by rings of this tissue.

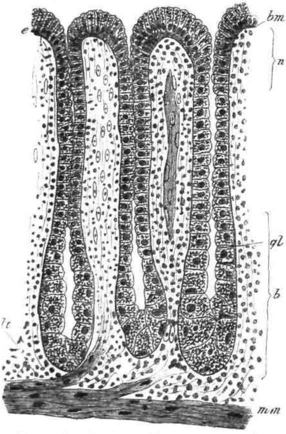


Fig. 18.—Section of mucous membrane of stomach showing simple glands. (After Schäfer.)

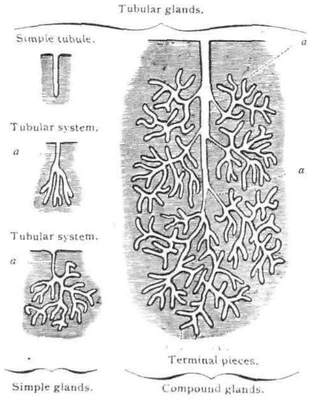


Fig. 19.—Simple and compound tubular glands. (After Stöhr.)

In all connective tissues there are spaces, some like long tubes, but mostly irregular in shape. The spaces are lined by ENDOTHELIUM, which consists of a membrane formed of flat cells one layer deep.

Epithelial Tissues.

Epithelial tissues are composed of cells with well-defined nucleus and a protoplasm that does not branch. The cells are never completely isolated one from another, and as a rule but little connective tissue is found in epithelial structures. In the skin and in the lining membrane of the gullet, tongue, and bladder, epithelium forms a membrane composed of several layers of cells; in the lining membrane or *mucous membrane* of the stomach, gut, and breathing passages it is one cell deep, each cell being joined to its neighbours by a small amount of cementing substance.

All glands which form a secretion and discharge this secretion by a duct are formed of epithelium. To understand the structure of a gland it is necessary to know that when epithelium is not merely protective, as it is in the bladder and the skin, it is either *absorbing* materials, as in parts of the food canal, or is *secreting*, that is to say, is manufacturing

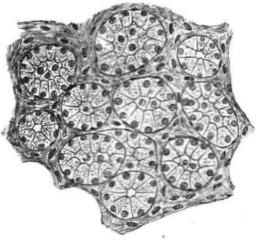


Fig. 20.—Typical section through gland. (After Harris.)

some substance out of the nutriment supplied by the blood, and is pushing this substance outside the cell walls into collecting tubes or ducts. Each gland may, in fact, be looked upon as a factory for the production of some special material; the epithelium of a salivary gland, for instance, secretes

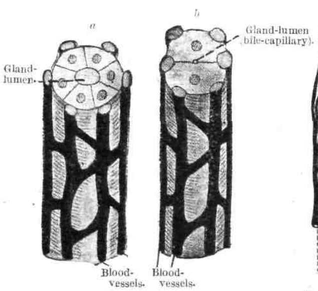


Fig. 21.—(*a*) Scheme of a segment of a terminal piece of an ordinary tubular gland. (*b*) Scheme of a segment of a terminal piece of the liver.

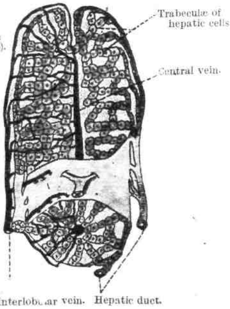


Fig. 22.—Scheme of liver lobule. (After Stöhr.)

saliva, the liver secretes bile, the lachrymal glands secrete tears, &c., &c. It does not follow, therefore, that the functions of all epithelium glands will be the same, even glands which are remarkably alike under the microscope may manufacture totally different substances.

Now, if a secretion has to be poured on a surface which is limited in extent a great increase in the number of active cells can be effected if portions of the surface are dimpled. This dimpled epithelial surface is in reality a gland, and is found as such in the inner wall of the gut and part of the stomach. But this process of dimpling can go much further, and the tube can be coiled as in the sweat glands, or branched as in the testis, or branched and with pockets on the branches as in the salivary and mammary glands and pancreas. A cross section through the tube or pocket gives the characteristic appearance shown in Fig. 20. The liver is in reality a gland of the second variety (branched tube) though here the structure is more complex than with glands generally.

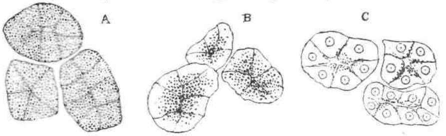


Fig. 23.—Gland cells. (*a*) At rest. (*b*) After a short period of activity. (*c*) After a long period of activity. (After Langley.

The secretions from these glands pass along ducts which are lined by a single layer of epithelium. In all cases the glands can be divided into lobes and the lobes into lobules, which are really terminal branches. Lobules are held to lobules and lobes to lobes by connective tissue.

The progress of secretion in a gland can be followed under the microscope. In a gland which has not secreted for some time the cells can be seen to be filled with granules which represent material ready for a rapid change into the special secretion of the gland: when the gland is stimulated

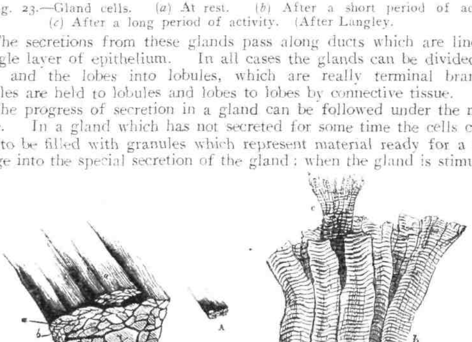


Fig. 24.—(*a*) Small portion of muscle natural size. (*b*) The same magnified five times. (*c*) A few fibres highly magnified. (After Sharpey.)

into activity the granules diminish in number whilst secretion is poured into the space or lumen between the cells. If a gland be stimulated to exhaustion no granules are visible, but on letting the gland rest the granules are built up anew from the nutriment brought by the blood.

Epithelium, when it forms skin, hair, nails, tooth enamel, horn, feathers, scales or transparent parts of the eye, is devoid of blood vessels, but glands composed of this tissue are richly supplied.

Muscular Tissues.

The essential elements in muscular tissue are cells in which the faculty of contractility is carried to a high degree of perfection. There are three types of this tissue from a functional as well as a microscopic stand-point. In the muscles attached to bones and which are under the control of the will, hence called *voluntary* or *skeletal* muscles, the cells are long, thin, unbranched cylinders which show a well marked cross striping, and have each a nucleus placed well to one side. Each cell is enclosed in a thin sheath of connective tissue which insulates one cell from another and helps to form the attachment to sinew or bone. The muscle fibres, formed of the cells and their sheaths, are grouped into bundles by means of connective tissue strands which carry blood vessels, nerves, and a variable amount of fat. A second form is *heart muscle;* here the cells are short and squat, have branches which unite with neighbouring branches, and have their nuclei in the centre. Like skeletal muscle cells they show a well marked cross-striping. A third form is *smooth* or *involuntary* muscle which is concerned with the movements of those organs such as the stomach, gut, bladder, uterus, &c., which are not under the control of the will. The

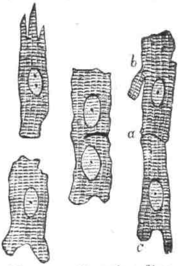


Fig. 25.—Muscular fibre cells from the heart. (After Schäfer.)

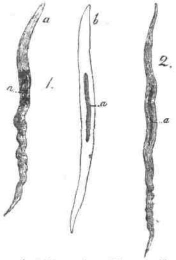


Fig. 26.—Muscular fibre cells from the muscular coat of the small intestines —"smooth muscle." (After Schäfer.)

cells here are short in length and taper at both ends. The nucleus is in the middle, and is elongated in shape. In both heart muscle and smooth muscle connective tissue carrying nerves, blood vessels, and fat is present, but it never forms an insulating sheath for the contractile cell.

Lymphoid Tissue.

This tissue, as it is found in the spleen, tonsil, lymph glands, &c., is simply areolar tissue packed with small round cells. The full significance of organs composed of this tissue we are far from understanding; the little that is known will be given in the chapter on blood.

Fat or Adipose Tissue.

With the exception of a connective tissue framework which carries blood vessels and nerves, adipose tissue is composed entirely of cells, in each of which an accumulation of fat has occurred to such an extent that the nucleus, with only a small amount of protoplasm around it, is pushed to one side.

Fat acts as a valuable store of fuel food; it also serves as a padding filling up spaces, and so holding organs in position and shielding them from injury; under the skin it forms a non-conductive layer which prevents the heat of the body from escaping too rapidly.

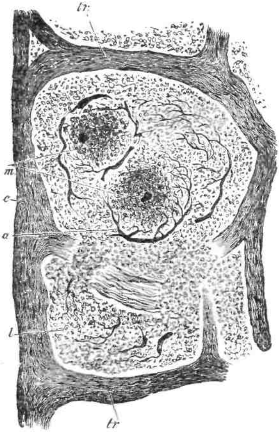


Fig. 27.—Section of spleen showing lymphoid tissue. (After Schofield.)

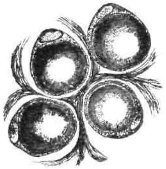


Fig. 28.—Fat cells, showing nuclei at the side. (After Klein.)

Other Tissues.

The blood, which is generally reckoned as a tissue, and the structures present in the nervous system, are so specialized and important that a description of them had better be deferred until their functions are dealt with.

THE MELBOURNE ROYAL AGRICULTURAL SHOW, SEPTEMBER, 1906.

A. T. Sharp, Assistant Editor.

The 1906 exhibition of the Royal Agricultural Society, which was held from the 4th to the 8th September, was a very successful one from practically every aspect. The weather conditions were very favorable, and the entries, which numbered over 6,000, constituted a record for any Australian

show. During the year many improvements have been effected at considerable cost by the society, and they tended to greatly increase the comfort of visitors. The stock exhibited were very high class. Thanks to the courtesy of the proprietors of the *Australasian*, a typical illustration is reproduced on the front cover of this journal; the cow shown is the champion Ayrshire, "Ada II. of Glen Elgin," the property of Mr. T. A. Grant, of "Glen Elgin," Toolern. The machinery and farm appliances were numerous and up-to-date, and were closely inspected. The financial result was eminently satisfactory, the profits totalling no less than £5,553.

As usual, the Department of Agriculture was well represented. Its special pavilion was thronged daily by sightseers, who were greatly interested in the exhibits of the various branches. Messrs. Crowe and Knight had the control of the exhibits, and were ably assisted by the other departmental officers.

The Dairy and Export branch had a splendid series of exhibits. First and foremost was that representing the butter industry. Some interesting figures which surrounded the exhibits struck the eye of each visitor. Since the inception of the export trade in 1888, Victoria's exports of butter have totalled £16,936,690. Whilst every one is pleased that such an extensive trade has been built up, it is also encouraging to know that it is capable of being largely developed. In 1905 Great Britain imported butter to the value of £21,585,632, of which we sent £1,736,789. We have therefore nothing to fear from over-production when this and many other markets are open to us. In addition to the butter, there was also an attractive exhibit of cheese of many kinds and sizes. Further on, milk in various forms—condensed, concentrated, sterilized, humanized, dried, &c.—was effectively shown. The meat export trade was well to the fore. Carcasses of mutton, lamb, and pork were on view, and proved a valuable object-lesson to many. For the sake of comparison, unsuitable carcasses were also hung, and showed clearly what should be avoided. In close proximity to the carcasses there was a fine display of tinned mutton, beef, and rabbit—roast, boiled, spiced, corned, lunch, &c. As in former years, poultry and eggs were special features. This department was under the superintendence of Mr. Hart, who also gave daily demonstrations of poultry dressing.

The exhibit of the Field Branch attracted a good deal of attention. Mr. Lee, Agricultural Superintendent, had a unique collection of soil cores, illustrating some of the different types of soil prevailing in Victoria. The cores, of which there were 50 on view, clearly showed the relative depths at which the changes in colour occur. The collection was quite original, and one calculated to arouse the interest of the public, and at the same time form the basis of an important development of soil investigation. Upwards of 100 other cores have also been secured, but owing to limited space they could not be shown. The mechanical analyses of several of the samples were also on view. The arrangement was very good, and the whole decidedly educational. Mr. Lee also had a nice collection of wheat, oats, and barley, grown last season on the various experimental plots.

Mr. J. Knight, of the Rural Industries Branch, had quite a varied collection under his control. Prominence was given to flax cultivation; the products of both the Linum and Phormium varieties were shown in all stages. Mr. Knight obtained a large amount of valuable information regarding the latter when he visited New Zealand recently, and was

therefore besieged with inquiries. Samples of the maize and cow pea seeds recently imported by the Department, and an effective exhibit of preserved and dried fruits, were on view. Throughout the show interesting demonstrations of fruit grading and preserving were given. A new method of preserving fresh fruit was brought prominently under notice by the exhibition of several cases of apples (Jonathan, Yates, Munro's Favorite, and others) and pears (Harrington's) which had been picked for upwards of 22 weeks, and were still in good condition. Certainly if the discoverer can obtain equally successful results with large quantities, the fruit trade will be revolutionized.

The Vegetable Pathologist (Mr. D. McAlpine) exhibited a large number of specimens and plates, illustrating the fungus diseases which affect cereals and fruit trees. An extensive collection of grasses was also staged.

The Entomological Branch was well represented, and Mr. French's collection of birds, insects, &c., was greatly admired. In these days, when

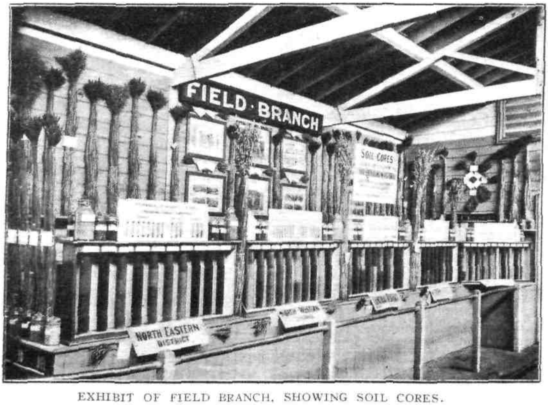


EXHIBIT OF FIELD BRANCH, SHOWING SOIL CORES.

nature study is receiving so much attention, it is not surprising that the fine lot of life histories of noxious and beneficial insects was closely inspected. Over 100 additional life histories were exhibited this year.

For the first time since the pavilion was erected, the Botanist's Branch was represented. The exhibit, although rather unpretentious, was nevertheless educational. The principal feature was the collection of "proclaimed plants" of Victoria, which are being dealt with in the *Journal*.

Advantage was taken by Mr. Kenyon, Engineer for Agriculture, to bring the benefits of the silo under the notice of visiting farmers. A partially built silo was erected outside the pavilion, and Mr. Kenyon was kept busy supplying necessary particulars to intending builders.

Mr. Seymour (Potato Expert) and Mr. Temple Smith (Tobacco Expert) had interesting exhibits, and dispensed a large amount of valuable information to growers. Every year brings an increase in the number of varieties of seed potatoes, and growers are naturally anxious to obtain the opinion of the departmental expert as to their value. The tobacco industry in Victoria is decidedly on the up-grade. Double the area is under cultivation, many growers are adopting up-to-date methods, a number of the best varieties have been established in the different districts suitable for their cultivation, and the market is improving.

The Publication Branch had a good stand, and the wall space was utilized to the fullest advantage in bringing the various publications of the Department under the notice of the producers, in whose interest they have been issued. The officer in charge, Mr. Kemp, distributed specimen

FIBRE EXHIBIT.

copies of the *Journal* to visitors. Mr. Bramwell, of the Closer Settlement Branch of the Lands Department, was also in attendance, and supplied suitable literature to inquirers.

The annexe allotted to the Agricultural Colleges was fully availed of. The majority of the exhibits were from Dookie College, but Longerenong College, which was recently reopened, also contributed some, which clearly showed that good work had already been done under the superintendence of the principal, Mr. Sinclair. "How Wheats re Made" was brought under prominent notice by Mr. Pye, principal of Dookie College, who has achieved considerable success as a hybridist.

FOURTH CONVENTION OF THE VICTORIAN CHAMBER OF AGRICULTURE, JULY, 1906.

(*Continued from page* 555.)

IX.—THE FRUIT INDUSTRY OF VICTORIA.

C. Bogue Luffmann, Principal, School of Horticulture and Small Farming, Burnley.

As I am constantly engaged in the training of fruit-growers and in the management of orchards, I will endeavour to explain the position and wants of the fruit-growing industry. From a fruit-growing stand-point, the position, climate, and natural resources of Victoria render her the most favoured of the southern States of the Commonwealth. Transit facilities are also the most expeditious. The local market for fruit is the greatest, and the first and general cost of orchard work is less than in any State except Tasmania. The natural rivals of Victoria outside the Commonwealth are few—Cape Colony and New Zealand alone having the same season and choice of fruits, such as are desired in the European markets. (Of such fruits as can be preserved, Victoria has many rivals, but, at the same time, advantages in season which enable her to maintain profitable trade.)

Victoria is the most self-contained of the Australian States, since she produces all the fruits she requires, excepting those of a purely tropical character. She also exports largely fresh fruits, dried fruits, and sweet preserves. No other State has a fruit trade of such magnitude, nor exports to so many markets. It is, therefore, my desire to place before you some important facts, and to enlist your sympathy in such ways as will give greater value to our fruit industry.

In the first place, we may ask which are the biggest questions for the growers, the State, and the business section of the community? I would direct your attention to the following points:—

1. The position and deficiencies of existing fruit-growers.
2. The functions, achievements, and aims of the State as an educational and guiding force.
3. The business side of the fruit industry.

The grower asks for general instruction and advice. It would be a mistake to overlook this fact. There is not a single branch or detail of the fruit industry of which many engaged in it are not hopelessly ignorant. Thus, one man, understanding and having good soil, knows nothing about trees or marketing. Another ignores draining or manuring or pests. A third cannot estimate the influence of climate, or make any intelligent and safe move. Many have irrigation water, and few know how and when to use it. Hundreds of men have chosen bad sites or unsuitable kinds for the climate, soil, and position they occupy; and thus we find in every district a great deal of discontent and a strong desire for instruction in the various branches of fruit-growing. Then the purely business side asserts itself, and I venture the statement that it is rare indeed that a good fruit-grower is also a good business man. The genuine lover of orcharding is shy of the world and its ways. Hence he has serious difficulties in selling his wares.

Let us not forget that the faculty for management is rare; that of every hundred men pitch-forked into fruit-growing—and they were pitch-forked into it some twenty years ago—not ten have such an all-round grip of themselves and their work as to warrant its being a satisfying and home-making venture.

Therefore, as I have said, the orchardist asks for general instruction. From the State he asks for *every* kind of assistance, but, of course, this is impossible, as no Government can endow a man with business habits, greater industry, a broader outlook, or that kind of intelligence necessary to successful orchard work. Shortly, I will tell you what the State can do, and then what the business world can do, to improve the conditions of the fruit-grower, and to give increase of value and permanence to the industry. But before I proceed to this let me say frankly that it is not given to every man who tries it to succeed by cultivating fruit. The orchard is no asylum for the fool or the idler; nor does it follow that sound intelligence cannot go wrong. If the natural aptitude for the work is not there, it matters not what may be. Summarized, as a people—

1. We lack order.
2. Work is intermittent where it should be constant.
3. The lack of self-control is all too frequent.
4. Money is the only thing sought, where a home is the most needful.
5. The disposition to make "a rise" and move on is painfully common, and amid all, the waste is awful.
6. Most orchardists fail to keep soil-making animals.

Admitting that all the above are ugly leak-holes and drains upon any estate, it will not be difficult to account for failure and discontent.

Instead of expecting anything to supplant work, the average grower must make up his mind to do more. He must both make and maintain his soil. He must not exploit and exhaust, but develop and enrich his land. He must stay at home, and feel at home. He must help to secure a reputation for his district rather than for his own bit of produce. He must keep such heavy animals as cows and pigs. I have been saying this for years, and, happily, it is now beginning to dawn on the fruit-grower that it is right. Every fruit-grower should keep cows and pigs in proportion to the amount of manure his soil and trees need. Of course, if he intends to remain a fruit-grower he will regard the animals as the merest by-products—soil-making factors. It is only near to towns and large natural manure supplies that animals may be disregarded. Such districts as Doncaster will always be independent of animals; whereas they should exist by thousands in all regions remote from towns. Now, I am aware that before we can induce the fruit-grower to do this we must teach him a great deal, and possibly eliminate a good many from the present list.

We must teach him in the aggregate, and, as far as possible, in the particular, a great deal that he does not know about soil and trees, sorts and seasons, markets and methods, and place before him as many profitable examples as we can in the way of well-managed and paying estates. Another serious—almost incalculable—loss has occurred through lack of concentration. Small men suffer from isolation; and every line of fruit would yield more in the aggregate if it were grown in fewer districts. It is rare indeed that the commercial fruit-grower succeeds best by having many sorts. And this applies to the growers of any one place. The

more unanimous they are in their choice the more likely they are to build up and maintain a safe market. We want certain districts to achieve reputations for certain fruits; and, further, we want to discourage planting in many quarters. Victoria has, roughly, four climatic zones, and these place our commercial fruits in four more or less distinct groups—North-west, north-central, high-central, and south coast.

Tasmania and Mildura are the two favorable examples of the value of concentration and unity of aim In both instances the growers have been compelled to adopt the same methods, and employ the same means of transit and marketing. The results forbid any argument. Now, the State is doing its part by—

1. Providing a School of Instruction, and complete orchards and accessories at Burnley.
2. By instruction through the medium of the *Journal*, and special reports.
3. By meeting every inquiry by post or in person.
4. By giving lessons in general orchard work throughout the State.
5. By having inspectors to advise about diseases and pests, and secure their eradication.
6. By six demonstration orchards, in as many zones, where special groups of fruit are chosen, and soils and men selected most capable of showing what can and should be done to secure a permanent return.

Now, I presume that a body of this importance is desirous of aiding every industry which it selects for discussion, and that being so, I would warn you against the danger of pushing the higher education of the agriculturist too far—that is, the training of those who are expected to become actual producers. Curious and hair-splitting students will be of no value in the field. I speak with some experience, and as much sincerity, on this subject. If we are to fit men for the land we must teach them by and on the land. A little theory and a great deal of solid practice is wanted. P. G. Hamerton—one of the sanest of writers on this subject, says—"No acquirement really becomes our own until we make constant use of it for ourselves. Educational experiments may provide the instrument, but they cannot insure its use." M. Rister, Director of the Institut Agronomique in Paris, declares — "Ordinary farm work cannot be successfully combined with scientific teaching. If you pursue both practice and theory, you will make bad practical men and bad scientific men. Our pupils require all their life for becoming practical men." Now, I know this to be absolutely true. I have had the training of hundreds of regular students, and I have met and advised thousands of men in all parts of the State, as well as in other countries, and I have always found that the studious student would make no fruit-grower—he was impatient of following the plough, or doing such a common-place job as packing apples. I must speak of these things because man is a part of our scheme, and if we fail to recognise the ordinary disposition of human nature, we shall make no improvement in this fruit industry.

I cannot refrain from saying a word in favour of the jam factories. Not so long ago the average grower disliked these exceedingly. Now they are recognised as a great boon. As a matter of fact, they have been the salvation of some branches of the fruit industry. And, as this is the result of intelligent organization, may we not hope to have merchant growers, just as we find in France, Spain, Italy, the Levant and America?

I know that it is almost dangerous to talk about servants and masters at this time of day, but there is no doubt that we have thousands of men on the land who, unable to manage entirely for themselves, would be infinitely better off if working as part of a large organization. I know that there are many difficulties in the way, as all the failures are not side by side or representing one industry. But, apart from any absorption of the existing small estates by large firms, the merchant producer, with his fruit farm, could help the industry amazingly. I have been trying for years to bring him into existence, and I must confess that so far I have been unsuccessful.

We need a large orchardist in every important district, equipped with the means of giving a thorough field experience to students who pass with credit through such institutions as Burnley, Rutherglen, and Dookie. It is impossible to teach business habits and general estate management in a school. The Principal manages, therefore all others are relieved of responsibility. There can be no wisdom in training boys with small or no capital on big estates. It is cruel! They may be schooled in large institutions, but their practical training must be on areas similar to what they are capable of owning or managing. This applies to agricultural training in all its forms, and it is a very remarkable fact that it has so far been completely ignored throughout the length and breadth of Australia.

It is for those depending on, and believing in, the fruit industry to improve matters by providing the field training. *Small men* have not the accommodation for students; hence the State may here and there assist. Failing any reliable instructor and leader in the country, the student must needs go amongst men less orderly and less informed than himself. He knows what is right, but lacks the power, through want of experience, of putting it into practice. Moreover, he may be an excellent man, yet entirely without capital. He cannot start as a manager, since he has too little experience, and large estates are too few and irregular. Now, what we can, and should do is to equip places in the country for the reception of our youths. Various ways are possible in the form of awards to the owners of these estates. Each needs a skilled manager, who might for a time at least be paid from three sources—the owner of the estate, the Government, and the district association. The four distinct training grounds wanted are:—

1. The State Institutions.
2. The merchant producer.
3. The State-aided fruit farmer (Department of Agriculture).
4. The large private grower, giving instruction in the field.

The industry would soon increase and improve in every way. All the above should be able to supply one or more fields. Consider the advantage of, say, only six such training grounds, taking two or three young men each year. In a very short time, we should have men seized of the necessities of every part of the State. Those places which are dragging and failing would be turned to shape and use, and a safe balance struck between purely scientific and practical field work.

I incline more and more to the belief that our teaching must be regional for, when all is said and done, you cannot apply any agricultural rule over a very big piece of country. Our University, public and State institutions, can give the ground work, but when it comes to obtaining experience, that must be sought where it is intended to apply it when gained. Hence, if we could have a fruit farmer working on thoroughly business lines, such an one would set up a standard for the whole district;

he would be a safe man to instruct others, and there would be no danger of youths desirous of becoming masters of the craft failing for lack of opportunity. I would have one of these in every district. I know that it would be difficult to find really good men and estates, but the difficulties are not insurmountable, and we shall have more serious ones unless we do something of the kind.

Now, if we adopt some such scheme as this, we can look into the future with some hope. We know the country better—its favorable and unfavorable areas. We can defend ourselves against booms and the boomer class. Of markets, we are well acquainted, and we know what is wanted, and what pays best. Enormous areas favorable to the growth of the best class of apples and pears, as well as the small preserving fruits, are to be found in the southern and central districts. The western district, and the drier parts of Gippsland, will yield the export fruit farms of the future. We must never forget that our only hope is in the young. If we will take a thoroughly disinterested view of our position and resources, and provide safe stepping-stones for those who would live by the land, the fruit industry can be made of great value in our industrial and social life.

X.—TELEPHONE LINES IN COUNTRY DISTRICTS.

John Hesketh, Chief Electrical Engineer, Postmaster-General's Department, Central Staff, Melbourne.

The intention of this paper is to describe briefly the different classes of telephone lines in country districts, the conditions under which they may be erected; and the best methods of erecting and maintaining such lines. It is just as well at the outset to consider how many different classes of country district telephone lines there are.

First, there are those entirely on the land of the user, such as those connecting a head station with out stations and boundary riders' huts, or connecting a farmer's residence with other buildings on a large holding.

Second, there are telephone lines which extend beyond the land of one individual to connect with a second farmer or station, but which lines do not go beyond the private lands of one or more persons.

Third, there are telephone lines which, in addition to being partly on private land, cross, or are erected for part of the distance along, public roads, to connect with the nearest post office, telegraph office, or telephone exchange.

By the *Post and Telegraph Act* 1901, Section 81, telephone lines of the first class may be erected by the user without any reference to the Postmaster-General, provided that the line does not go beyond the land in the occupancy of the user. If, however, the line does cross any public road, or extend into the land of any other owner, and so becomes a line of the second class, then the permission of the Postmaster-General must be obtained before the line is erected. This is necessary so that control of all telegraph lines (which includes telephone lines also), which has been vested in the Postmaster-General, may be conserved. Without some such control no properly co-ordinated system of telephones could be efficiently and economically constructed. The regulations as to such lines are, however, made as liberal as possible, and the licence-fee charged by the Postmaster-General on the portion of wire erected by the user is only 1s. per annum for each holding over which the wire passes.

The third class of line, that used to connect farms or stations with the nearest post office, telegraph office, or telephone exchange, may be constructed partly by the user and partly by the Postmaster-General. Speaking generally, the Postmaster-General reserves the right to construct any telephone line within a town boundary, the user constructing the portion outside the town boundary, or where poles of the Postmaster-General are not available. There are, however, surveyed townships which are not closely settled, in which it may be advisable that the Postmaster-General should grant permission for the users to erect the whole of such lines, even up to the post office. The revised regulations provide for this. But when the country district lines have obtained connexion with any post office, it is quite possible that this particular post office may have no connexion with the general telegraph or telephone system of the Commonwealth, and the question naturally arises, how is such a connexion to be

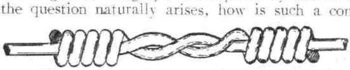


Fig. 1.—Twist Joint, 400-lb. G.I. Wire.

obtained? In such a case the regulations provide that the telegraph or telephone service will be extended to the post office on one or other of the following terms:—

First, without guarantee: when it is shown that the annual revenue will equal 10 per cent. of the capital cost, plus the cost of operating.

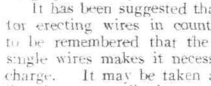
Second, with a guarantee: when the revenue is not estimated to equal at once the amount required as stated in "First," but is estimated to equal this amount within seven years. In this case the guarantee is to be in two parts, first—a cash guarantee equal to the difference between the revenue required and the estimated revenue for two years; and second —a bond or guarantee that for five further years (that is making seven in all) the guarantors will make good any deficiency in the amount necessary to bring the estimated revenue up to the required revenue.

Third, when the persons interested do not wish to give a guarantee, they may construct the line themselves, and receive from the Postmaster-General two-thirds of the earnings of the line for telegraph and telephone messages locally; that is to say, in the two-thirds of the revenue paid to the constructors of the line, or persons nominated as trustees, there would not be included any portion of the cable charges for a telegram to, say, England, but the two-thirds would be two-thirds of the charge for the transmission of the message over the portion of the line erected by the persons interested.

It is difficult to set out in a brief but intelligible form, the charges made by the Department for the various services mentioned, but attached are copies of the regulations which give full details. If these regulations are not understood, or if they do not seem to apply to any particular case, the Department will be only too glad if particulars of any desired line are submitted, so that definite terms may be quoted. It appears to be the impression in parts of Australia that the Post and Telegraph Department will not allow would-be users to erect their own lines, and, further, that the charges imposed by the Department are excessive. The foregoing notes and a study of the regulations will show that the Department does allow people to erect telephone lines for themselves. Indeed it would appear to be impossible for the Department to do otherwise in many country districts. All the Department can do is to reserve the right

to erect lines within settled townships and along some roads, but even in the latter case of lines along country roads permission is given for the users to erect the line where such a line will not interfere with the telegraph lines of the Postmaster-General, or unduly interfere with any other telegraph or telephone lines.

It has been suggested that the charges made by the Postmaster-General for erecting wires in country districts are unreasonably high, but it is to be remembered that the cost of sending men long distances to erect single wires makes it necessary to meet such cost by an apparently high charge. It may be taken as true in 99 per cent. of cases that telephone lines in country districts can be erected more economically by the user than by the Department; for the user knows the country, knows where timber can be obtained, the cheapest way of getting it, very often has labour which can be utilized without any increased expenditure, and, further, can adopt a lighter and cheaper method of construction than the Department can, because the user is always on the spot ready to make good any trivial defect, whereas the Department would have to send men considerable distances to effect repairs, and therefore must erect substantial lines which would not be liable to interruption. With this one exception, I consider



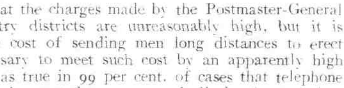


Fig. 2.—No. 5 (Acme) Insulator. Fig. 3.—Bent-stem Insulator and Stem.

that the charges proposed are very reasonable. They are, so far as I am aware, lower than obtain in any other English-speaking community. An example is given later of the charges made in a particular case.

It has been said by some farmers that they do not know anything at all about electricity, and therefore cannot erect a telephone line. To erect a telephone line does not require any more expert knowledge, nor is it any more difficult, than to build a wire fence. Speaking generally, for lines, say, not exceeding 40 miles in length, and having but one or two instruments connected, galvanized iron wire, weighing 200 lbs. to the mile, is quite good enough. For short lines under, say, 10 miles, wire as light as 150, or even 100 lbs. per mile is sufficient. The reason for using galvanized iron wire as against black wire is that it lasts longer, and is, therefore, cheaper in the long run. Steel or copper wire is unnecessary; galvanized iron wire is quite good enough in most instances for short lines. For longer lines, or for those serving several points, heavier wire may be used with advantage, and in some cases the use of copper wire may be justified eventually. The circumstances of each case must determine the kind and size of wire used, but on this point the Department will be glad to give any advice desired. For joining galvanized iron wire the ordinary twist joint (Fig. 1) is quite satisfactory. This joint is improved by being soldered, but many

lines have been in use for many years on which such joints have not been soldered. Figure 7 indicates methods of attaching the wire to the insulators.

A very important point in erecting wire is to take care that it is not stretched too tightly. The influence of temperature on wire is best shown by the statement that in a 50 yards' span of iron wire, at a temperature of 100 degrees Fahr., the sag is 2 feet, while at 30 degrees it is only 6 inches. Now, if the wire had been stretched in summer so that it sagged only 6 inches, when the temperature dropped in winter the wire would snap or stretch so much as to considerably reduce its strength. It is, therefore, advisable to erect wire to a carefully-prepared table of sags. Such a table is given below. If this table does not meet the conditions of users, and the Department is approached, tables for shorter spans and other wires will be supplied.

SAGS FOR IRON WIRE FOR SHORT SPANS.

Factor of Safety of 3 at 30° Fahr.

Temp.	Iron.					
Fahr.	50 yards.		60 yards.		70 yards.	
°	'	"	'	"	'	"
30		5·9		8·5		11·6
35		8·7		11·4	1	2·7
40		11	1	1·8	1	5·3
45	1	0·6	1	3·8	1	7·5
50	1	2·2	1	5·5	1	9·46
55	1	3·5	1	7·1	1	11·3
60	1	4·8	1	8·7	2	1
65	1	6	1	10	2	2·6
70	1	7·1	1	11·3	2	4·1
75	1	8·2	2	0·6	2	5·5
80	1	9·1	2	1·8	2	6·9
85	1	10·1	2	2·9	2	8·1
90	1	11·06	2	4	2	9·4
95	1	11·9	2	5	2	10·6
100	2	0·8	2	6·01	2	11·7
105	2	1·6	2	7	3	0·9
110	2	2·4	2	7·9	3	1·9
115	2	3·2	2	8·8	3	3
120	2	4	2	9·7	3	4

Insulators.—Insulators may be of various kinds, depending upon the purpose for which they are to be used. Figure 2 shows the large telegraph insulator. It is seldom that such an insulator is required on country lines. Its use would involve the use of an expensive bracket and pin, and is unnecessary. Figures 3 and 4 show smaller sizes of insulators and pins, which would prove quite satisfactory on any line, even up to 50 miles in length. Figure 5 shows an ordinary button insulator, which is quite good enough for securing wires on fences, when the length of line does not exceed, say, 20 miles. On short poles, the insulators (Figs. 3 and 4) may be used with advantage.

The selection of supports for the wire is a matter which must be left in each case to local judgment. If fences with wooden posts are available, they may be used in many cases, or if the fence posts themselves are not used, then saplings or sawn timber secured to the wood fence posts

would suffice. It is to be remembered that the purposes of the support are—(1) To keep the wire out of harm's way—that is to say, from being damaged by cattle, or pedestrian or other traffic, and prevented from doing damage to such traffic or animals; and (2) to keep the wire off the ground, so that the current may not be diverted from its proper path. In the selection of the supports for use on private property, the Department leaves the users the fullest liberty, but with the liberty the responsibility is also given to the users, who must, of course, obtain the consent of owners of other private lands over which they wish to erect a line.

When, however, such a line is erected across a public road, the conditions of the *Post and Telegraph Act* must be complied with. That is to say, the wire must be secured to substantial supports, and must be at least 18 feet above the surface of the roadway at all crossings. When wire is erected along the side of a roadway, it is advisable that it be erected just inside the fence on the adjoining properties, so that shorter poles might be used.

In the selection of a telephone instrument, a certain amount of technical knowledge is required, but the Postmaster-General places the knowledge of his officers on such technical points at the disposal of any telephone user. Not only so, but the Department is prepared to sell to any user the

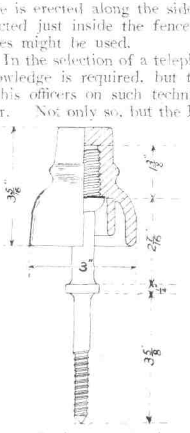


Fig. 4.—Straight-stem Insulator and Stem.

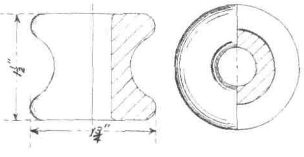


Fig. 5.—Button Insulator.

material and instruments necessary to erect a line to connect with any post office, telegraph office, or telephone exchange, at prices shown approximately in the following list:—

APPROXIMATE PRICE LIST.

Telephone Material for Use on Country District Lines.

Wire, galvanized iron (weighing 400 lbs. per mile), £14 0s. 7d. per ton
Wire, galvanized iron (weighing 200 lbs. per mile), £14 13s. 5d. per ton.
Insulators, large P.O. pattern (Fig. 2), 5¾d. each.
Insulators, small button pattern (Fig. 5), 1d. each.
Insulators, small, with bent stem (Fig. 3), 7d. each.
Insulators, small, with straight stem (Fig. 4), 6½d. each.
Insulators, small, without pins (Fig. 3 or 4), 2¾d. each.
Telephone wall sets, complete, Ericsson pattern (batteries included), £3 18s. 10d. each.

NOTE.—All the above prices are subject to variation at any time, and are for the items delivered at the Department's Stores, Melbourne; packing, &c., extra.

Any one wishing to buy a telephone instrument may be satisfied to accept those which will comply with the Postmaster-General's Department's specification for "branching system" telephones. A "series" telephone should not be accepted. This latter kind of instrument will work very well when only one instrument is to be used on one wire, but when more than one instrument is to be connected on one wire, the instruments should be what is known as the "branching system" pattern.

The use of one instrument only on one wire is most uneconomical. In America, where country district telephones have been more widely availed of than in any other country in the world, as many as twenty telephones are connected to one pair of wires. It is admitted that such an arrangement is not secret, but if secrecy on a country district line is to be attained, it must be at a cost which, in my opinion, is out of all proportion to the benefits. Secrecy can only be obtained by having metallic circuits, and connecting only one instrument on each such circuit, and even then something will go wrong with the wire just when the secrecy is most desired, and the secrecy will fail. It must, however, be clearly understood that a metallic circuit, that is, two wires, gives a better service than a

Fig. 6.—Method of Binding Wire to Straight-stem Insulator.

single wire. If more than four instruments are to be connected to any circuit, then a single wire will be found objectionable, and a metallic circuit much preferable. It is far more difficult to preserve secrecy on long country district lines than on those in cities. It is far better to assume that you will not have a secret system, and if you must transact confidential business over the telephone, arrange to do it by means of codes.

As showing the effect of the use of telephone lines by more than one person on the rates now offering for country district lines, the following figures are interesting:—

Under the new regulations, the Postmaster-General will erect a mile of wire to the boundary of a town, and give exchange service up to 760 calls per annum for £4 a year for one user. This user erects the line beyond the town boundary to connect with that portion provided by the Postmaster-General, and provides the instrument at the user's end. Should other farmers connect to the same line, the charge is increased by £2 for each additional user, so that five users would pay a total of £12, or £2 8s. each (in addition to the licence-fee of 1s. or 2s. per annum, as the case may be), and for this payment they would *each* be entitled to the following privileges:—

760 calls yearly (380 half-yearly) on the exchange locally, free.

Additional calls, ½d. each.

Transmission and receipt of telegrams over the telephone line, free of extra charge for telephoning.

Sending local telegrams for 3d. each.

Local conversations with non-subscribers, 3d. each.

Conversations with other people *on the same wire*, free.

One important part of single-wire circuits (if not the most important) is the connexion to the earth. It is to be remembered that the telephone current must have a complete path or circuit provided for it. The current may travel outwards by the wire, and return by the earth, or if two wires are provided, may travel outwards by one and back by the other. When only one wire is used there must be a good earth connexion at each end. Many defects on telephone services are caused by defective earth connexions. The best earth connexions are those which connect to the pipes of a water-supply system, but the pipes must be laid underground for a considerable distance, and the joint between the wire and the pipe very carefully made. If no water-pipe is available, a plate of galvanized iron, from $\frac{1}{8}$ to $\frac{1}{4}$ inch thick and 3 feet square, should be buried in loose, damp soil in a hole 5 feet deep, a stout wire (say, No. 8 S.W.G.), or two finer wires, being firmly soldered to the plate. Great care should be taken in securing the wire to the plate. If a plate of iron is not available, then a coil, 3 feet in diameter, and consisting of 20 turns, of No. 8 wire may be used instead; or a piece of 2-in. galvanized iron piping may be driven 6 feet into the ground and the wire connected to the top. All connexions to earth plates should be soldered. The earth in which the plate is buried should be as damp as can be found. Do not bury the earth plate in rocky or dry ground. If necessary, go some distance away to find more suitable

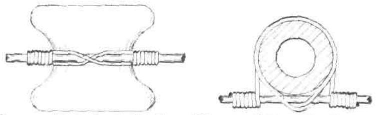


Fig. 7.—Method of Binding Wire to Button Insulator.

earth. The bank of the nearest water-hole will do very well as a site for sinking the earth plate. Take great care that the wire leading from the earth plate to the instrument does not get broken or corroded, especially about the ground level.

Procedure.—If a telephone line in a country district is desired, the best procedure is to at once write to the Deputy Postmaster-General, stating clearly what is required, and ask for full information as to conditions and terms. If any technical information is required, the same course should be followed. For any further general or technical information the Department places itself unreservedly at the disposal of persons desiring to erect such wires to connect with its telegraph or telephone system.

REGULATIONS.

PART X.—TELEPHONE LINES CONNECTING WITH TRUNK LINE SWITCHBOARDS, OR TELEGRAPH OFFICES ONLY.

71. Telephone lines connecting a subscriber with a telephone trunk line switchboard only, and not available for any purpose other than conversations over trunk lines, for which conversations the rates specified in Regulation 47 are to be paid, or telephone lines connecting a subscriber with a telegraph office for use only in connexion with the transmission of telegrams at the prescribed rates, will be provided on payment of the following rates annually in advance, and subject to the same general conditions as lines to telephone exchanges, Part I.—

For a line not exceeding one mile radially from the trunk line switchboard, together with one instrument and the necessary connexion to the trunk line switchboard ... ...

For each additional half-mile of line or fraction thereof ...

PART XI.—TELEPHONE LINES IN COUNTRY DISTRICTS NOT ERECTED, OR ONLY PARTLY ERECTED, BY THE POSTMASTER-GENERAL.

72. The Postmaster-General reserves the right to erect all private lines within the boundaries of any railway line, municipality, township, or village, or along any public road.

73. (1) Any person wishing to erect a private telephone line passing beyond the boundary of his own land must make application for permission to the Deputy Postmaster-General.

(2) With the application must be forwarded (*a*) a plan showing the route to be followed, especially marking where roads are to be crossed or entered upon, and the places to be connected; and (*b*) a description of the proposed method of constructing that portion of the line which is not upon private land.

(3) Where the line is erected upon private land the method of construction shall be at the option of the persons constructing the line, subject to the approval, in writing, of the owners of the land, the onus of obtaining which approval shall lie upon the persons constructing the line.

(4) Where the line is erected upon public land of the Commonwealth or of a State, or on or across a road, railway, track, or other place used for traffic or accessible to the public, the method of construction and the poles and other material to be used shall be subject to the approval of the Deputy Postmaster-General, but the approval shall not be unreasonably withheld.

(5) The Deputy Postmaster-General may direct an officer of the Department to examine the application and the accompanying particulars, and, if necessary, make an inspection of the route.

(6) The cost of such inspection shall be borne by the person wishing to erect the line.

(7) Should the report of such officer disclose that the line will not in any way interfere with or endanger any other line of telegraph, whether belonging to the Postmaster-General, the Railway authorities, or any private person, and that the material and method of erection to be adopted for the construction of that portion of the line which is not upon private property are satisfactory, the Postmaster-General may, upon payment of the prescribed fees, grant permission to erect such line.

(8) Provided, however, that such permission shall in no case be granted where a line is to run from a point in the vicinity of a telegraph office to another point in a like vicinity unless the line is to connect to or through a telegraph office.

74. Permission shall not be granted for any such line to be erected along any public road, railway, or track, unless the Deputy Postmaster-General is satisfied that it is in every respect unobjectionable, and that the consents of the Railway and local authorities, where necessary, have been obtained.

75. Permission will not be given to erect private telephone lines along a public road, railway, or track where poles of the Postmaster-General are already available for those lines.

76. If the line crosses a road, track, or other public place, the height of the wire above the highest portion of the road, track, or public place, shall not be less than 18 feet, and the poles carrying the wire at any of those places shall be of substantial character, and be strutted or stayed, if necessary, to stand the strain of the wire.

77. The person to whom the permission has been granted shall, upon the completion of the line, inform the Deputy Postmaster-General thereof, and an officer of the Department may then be sent to inspect the line and report whether it has been constructed in accordance with these regulations. The cost of such inspection shall be borne by the person to whom permission to erect the line has been given. If the line has not been constructed in accordance with these regulations the inspecting officer shall issue instructions as to what is required, and, on the defects being made good, a licence to use the line may be issued.

78. Should the person to whom permission has been granted to erect the line fail to construct it in accordance with, or to comply with, the requirements of these regulations, the Deputy Postmaster-General may take such steps as he deems necessary to obtain compliance with the regulations, and a licence to use the line shall not be issued until the requirements of the Deputy Postmaster-General have been satisfactorily complied with; and any expense entailed upon the Department in connexion therewith shall have been paid by the person concerned.

79. On the completion of the line to the satisfaction of the Deputy Postmaster-General, a licence to use it shall be issued. A licence-fee of 1s. per annum, payable in advance, shall be charged, irrespective of the length of the line. This fee covers only the use of one line connecting two points. If additional points are connected,

whether by means of a switchboard at a central switching point, or by direct connexions to the line, a further fee of 1s. per annum for each additional point so connected shall be charged, and, in the case of a line joining two separate holdings, a separate licence-fee shall be charged for each holding occupied by a different lessee, irrespective of the length of the line.

80. Where the line is erected partly on existing poles, the property of the Postmaster-General, a sum of 25s. per annum per mile of wire, or portion thereof, shall be charged for the portion so erected, in addition to the licence-fee mentioned, the wire on these poles shall be erected and maintained by the Postmaster-General, and the licensee must undertake to rent the line for a period of at least six years.

81. (1) If a private telephone line connect with a telegraph office, the following charges shall be payable in respect of such connexion :—

(2) For every telephone which connects or can connect with any telegraph office, whether the connexion is direct or by means of a switchboard at a central switching point upon the privately-constructed line, a fee of £1 per annum to cover the cost of attention to and maintenance of the telephone and other apparatus to be provided by the Postmaster-General for use at the telegraph office.

(3) The telephone for the use of the licensee may be either provided by him or purchased from the Postmaster-General, but must be maintained by the licensee to the satisfaction of the Postmaster-General.

82. Where two or more such telephone lines in country districts not erected, or only partly erected, by the Postmaster-General connect with any telegraph office, inter-communication between them will be given upon payment of the fees prescribed by Regulation 97, Part XIII.

83. If a private telephone line connect with a telegraph office, telegrams received or intended for transmission over the wires of the Postmaster-General in the usual way will be received or transmitted over such private telephone line on payment of the ordinary telegraphic charges only.

84. (1) Every message passing in either direction between any point connected with any private telephone line and the telegraph office to which such line connects, shall be charged for at the following rates :—

(*a*) For every message intended for delivery within a radius of one mile from the telegraph office to which the private telephone line connects ... ... 3d.

(*b*) For every message handed in at the telegraph office to which the private telephone connects for transmission over the private telephone line to the licensee's office ... ... 3d.

(2) Regulations 83 and 84 apply not only to telegrams and messages upon the business of the licensee, but also to telegrams or messages from or to any other person, which telegrams or messages may be transmitted over the licensee's wire with his consent, but no charges other than the charges specified in these Regulations may be made for such communications. (*See also Regulation* 88.)

85. The licensee shall deposit in advance with the officer in charge of the telegraph office with which the private line is connected, a sum calculated to meet the cost of all telegrams, conversations, or messages likely to pass over the line for a period of one month, such deposit to be renewed monthly, or more frequently if necessary, and the licensee must accept as correct the statement of such officer as to the charges payable by such licensee.

86. (1) For conversations over any such private telephone line connected with a telegraph office, the following charges shall be made :—

(*a*) For a messenger sent to call any person residing within the usual radius of free delivery of telegrams to the office ... ... 3d.

(*b*) For a messenger sent to call any person from beyond the radius of free delivery of telegrams, the usual porterage charges in addition to the above-mentioned charge of 3d.

(*c*) For every conversation ... ... 3d.

(2) This regulation applies not only to conversations between the licensee and any other person, but also to conversations between any two persons who use the line with the licensee's consent, but no charges other than the charges specified in these Regulations may be made for those conversations. (*See also Regulation* 88.)

87. Provided, however, that the facilities mentioned in Regulation 86 shall be given only when the telephone is so placed in the telegraph office as not to require access to the portions of the office premises which, by regulation, are not open to the public; and that the facilities mentioned in Regulations 84 (1*a*) and 86 (1*a*) *and* (*b*) shall be given only at offices where the delivery of messages is undertaken.

88. The licensee of a private telephone line shall not make any charge beyond those specified in these regulations for the transmission of any communication over such line, nor shall he receive any valuable consideration for such privilege without the authority of the Postmaster-General. (*See Post and Telegraph Act* 1901, *Section* 129.)

89. The Deputy Postmaster-General may direct an official inspection to be made periodically of such portions of the telephone lines as are not upon private lands, and the officer making the inspection may direct the licensee to make such alterations or repairs as to him appear necessary, and the licensee shall immediately carry out his directions. In the event of the licensee failing to do so within a reasonable time, the officer shall report to that effect, and the licence to use the line may be cancelled. Periodical inspections under this regulation shall be made free of cost to the licensee of the lines.

90. (1) The licensee shall be wholly responsible for the repair and maintenance of the line (except as regards the portion of it erected on poles the property of the Postmaster-General, and therefore maintained by the Postmaster-General) to the satisfaction of the Deputy Postmaster-General, and he shall undertake to maintain the same in a thoroughly efficient manner at his own cost, and any alterations, repairs, or other works which the Deputy Postmaster-General may, in the interest of the public safety or convenience, order to be done, shall be performed by the licensee, or, if undertaken by the Department, shall be charged to the licensee, in which latter case the amount due may be recovered by the ordinary process of the law.

(2) If any portion of the telephone line is erected and maintained by the Postmaster-General, means will be provided by the Department for separating the portion from the privately-constructed portion at will, so that defects may be localized.

91. The licensee of a private telephone line shall be responsible for any injury to life, limb, or property caused by the poles, wire, or other parts of the line (except, however, such portion of the line as is erected on poles the property of the Postmaster-General, or which is maintained by the Postmaster-General).

92. Where a private telephone line does not connect with a telegraph office, the licensee shall undertake that it shall be used for his own private purposes only, or by those authorized by him with the approval of the Deputy Postmaster-General to connect by telephone *en route*.

93. In the event of a private telephone line being found to interfere in any way with the erection of any line by the Postmaster-General or the Railway authorities, the Deputy Postmaster-General may direct that the private telephone line be altered, removed, re-erected in another position, or otherwise dealt with, as he deems necessary.

94. (1) The Deputy Postmaster-General may authorize the use, by any Government official on public business, of any private telephone line erected under the provisions of these regulations.

(2) If the licensee of a private telephone line refuses to allow any such official, authorized as aforesaid, to use such line, the licence issued in respect thereof may be cancelled.

95. All fees must, unless otherwise provided by these Reguations, be paid annually in advance.

PART XIII.—TELEPHONE LINES IN COUNTRY DISTRICTS PARTLY ERECTED BY THE POSTMASTER-GENERAL, AND WHICH CONNECT WITH TELEPHONE EXCHANGES.

97. Where privately-constructed lines exist, or are subsequently erected to connect with any town in which a telephone exchange is in operation, or to which a telephone trunk line connects, they may be connected with the telephone exchange or trunk line switchboard on the following terms:—

(*a*) If poles of the Postmaster-General are available, the portion of the lines within the boundaries of any township shall be erected and maintained thereon by the Department.

(*b*) Where poles of the Postmaster-General are not available, and it is not considered desirable that they should be erected by the Department, permission may be given for any portion to be constructed by the user of such privately-constructed line.

(*c*) Where the portion of the line erected by the Department joins the portion erected by the user, the Department will provide a means of separating the two portions at will, so that defects may be localized.

(*d*) For any portion of the line erected by the Department the following annual charges shall be made :—

For any distance up to one mile, £4.

For each additional half-mile or portion thereof of single wire, 12s. 6d.; of metallic circuit, £1.

(*e*) In cases where the line is extended so that more than one point can communicate with the exchange—

For each additional point £2

(*f*) Mileage of the portion of the line erected by the Department will be calculated radially from the exchange as a centre.

(*g*) The charges specified in (*d*) and (*e*) include—

(1) 190 originating calls per quarter from each station through the exchange.

(2) Unlimited calls between any two stations on the same line, such calls not requiring the attention of the exchange.

(3) Provision of all apparatus at the exchange or trunk line switchboard.

(4) The transmission by telephone, without extra charge, of telegrams on which the ordinary charges for transmission over the wires of the Postmaster-General have been paid.

But the provisions of Regulations 84 and 86 shall apply and the charges specified therein be made when the services provided for therein are required.

A licence-fee of 1s. per annum shall also be paid.

Calls through the exchange beyond 190 per quarter per station connected shall be charged one halfpenny each.

98. A person by whom any portion of such a line has been erected shall construct and maintain it, and maintain the instruments connected with it to the satisfaction of the Deputy Postmaster-General. The Postmaster-General will not be responsible for any portion of the line not erected by or for the Department.

The telephones for use on the lines must be of a pattern approved by the Deputy Postmaster-General, and must be maintained to his satisfaction by the licensee.

99. The cost of any necessary inspection of the line or instruments connected therewith shall be paid by the person for whose use the line has been erected.

100. Should the person using the line not maintain the portion constructed by him, or the instruments connected therewith, to the satisfaction of the Department, after reasonable notice has been given him so to do, the service at the exchange may be discontinued without prejudice to the right of the Postmaster-General to recover any fees payable by him.

101. (1) Where any line of the Postmaster-General is erected on the same route as a privately-constructed line, the Deputy Postmaster-General may call upon the owner of the latter line to remove it, and the owner may be allowed to use, in lieu of the line to be removed, a wire upon the poles of the Postmaster-General, on the terms prescribed by these Regulations.

(2) The Postmaster-General may take over any privately-constructed line if it is suitable, on such terms as are agreed upon.

102. Where they do not conflict with any regulation in this Part, the regulations contained in Part XI. shall also apply.

PART XIV.—ERECTION OF PUBLIC TELEGRAPH OR TELEPHONE LINES UNDER GUARANTEE.

103. Any person may apply in writing to the Postmaster-General for the construction of a telegraph or telephone line under these Regulations.

104. Each application will be dealt with on its merits, but no application will be granted unless the Postmaster-General is satisfied that the line applied for is required in the public interest.

105. No application shall be granted for the construction of a line not likely to yield a minimum revenue within a period of eight years after the construction of the line, unless the Postmaster-General is satisfied that there are special circumstances rendering its construction desirable.

106. If the line is not likely to yield, annually, an amount sufficient to provide—

(*a*) For the cost of operating the line; and

(*b*) Ten per centum on the cost of constructing the line and supplying the instruments (to cover maintenance, renewals, &c.)

(which amount is referred to in these Regulations as a minimum revenue), the

applicants shall, for the purpose of guaranteeing the receipt of that amount, comply with the following conditions, namely :—

(*a*) The applicants shall deposit with the Postmaster-General a sum of money equal to the difference between the estimated revenue from the line for two years and the minimum revenue for two years.

(*b*) The applicants shall enter into a joint and several bond, in a sum to be fixed by the Postmaster-General, conditioned to make good, to an extent not exceeding the difference between the estimated revenue and the minimum revenue, any sum by which the receipts from the line in any year, during a period of seven years after the completion of the line, fall short of a minimum revenue.

107. The sum deposited with the Postmaster-General shall be placed to his credit in a Savings Bank, and such sum and any interest thereon shall be available for the purpose of making good in any year any amount by which the yearly receipts from the line fall short of a minimum revenue, and the sums required for that purpose may be withdrawn from the bank and paid to the Consolidated Revenue Fund at such times as the Postmaster-General thinks proper.

108. The bond shall be in a form approved by the Postmaster-General, and payments under it shall be made within one month after demand by the Postmaster-General; but no such demand shall be made so long as the sum deposited, or any balance thereof, is sufficient to make good the amount required.

109. After the expiration of seven years from the completion of the line, the bond may be renewed or a new bond executed for such further period as the Postmaster-General directs, and if the bond is not so renewed, or a new bond executed, the Postmaster-General may, unless he is satisfied that the line will yield a minimum revenue, remove it and the instruments.

110. Any balance of the sum deposited or interest thereon may, after the expiration of seven years from the completion of the line, be returned to the applicants.

111. The line and instruments shall remain the property of the Postmaster-General.

PART XV.—PUBLIC TELEGRAPH (OR TELEPHONE) LINES ERECTED AND MAINTAINED BY THE PERSONS DESIRING SUCH LINES, INSTEAD OF BY THE DEPARTMENT UNDER GUARANTEE.

112. In cases where the estimated probable telegraph (or telephone) revenue is not sufficient to justify the erection and maintenance by the Department of a telegraph (or telephone) line for public use without guarantee, and where it is considered by the persons applying for the erection and maintenance of a telegraph or telephone line, that it will be to their advantage to construct and maintain the line at their own expense, the Postmaster-General may authorize the construction and maintenance of the line by those persons subject to the following conditions :—

1. The erection of the line shall be subject to the Regulations contained in Part XI. of these Regulations, so far as they are applicable, but so that—

(*a*) Notwithstanding anything contained in the *Post and Telegraph Act* 1901, or in any regulations, the persons constructing the line shall not have or exercise any power to enter upon or interfere with any private land without the consent, in writing, of the owner thereof, the onus of obtaining which consent to lie upon the persons constructing the line.

(*b*) Where the line is erected upon private land, the method of construction shall be at the option of the persons constructing the line, subject to the approval, in writing, of the owners of the land, the onus of obtaining which approval shall lie upon the persons constructing the line.

(*c*) Where the line is erected upon public land of the Commonwealth or of a State, or on or across a road, railway, track, or other place used for traffic or accessible to the public, the method of construction, and the poles and other material to be used, shall be subject to the approval of the Deputy Postmaster-General, but the approval shall not be unreasonably withheld.

(*d*) No licence-fees shall be charged.

2. The persons constructing and maintaining the line shall nominate and submit to the Postmaster-General the names of one or two persons as the trustees for the line, to represent them, and to receive on their account the amounts payable by the Postmaster-General, as hereinafter provided, for the use of the line for public purposes.

3. Upon the completion of the line the Postmaster-General may make arrangements for its use for public business, and provide for such attendance as may be necessary for operating the line at the cost of his Department.

4. The charge for the use of the line by all persons, including those by whom it has been erected, and by whom it is to be maintained, shall be those prescribed by the Act or Regulations, for the time being, for telegrams or telephonic conversations.

5. In consideration of the erection and maintenance by the persons concerned of the line for public business, the Postmaster-General shall pay to the trustees for the line such a sum as is from time to time agreed upon, but not more than will equal a payment for every message transmitted from the new offices on the line of two-thirds of the rates prescribed for suburban telegraph messages, or not more than two-thirds of the rate prescribed for telephonic conversations with the office with which the line is directly connected.

6. The Postmaster-General may at any time take possession of the line, paying to the owners thereof such compensation as is agreed upon, or, failing agreement, as is settled by arbitration, as provided by section 155 of the *Post and Telegraph Act* 1901.

PART XVI.—MISCELLANEOUS.

113. Amendments may from time to time be made to the Regulations, and amendments so made may be made applicable to the services established before the commencement of those amendments, as well as to services established after the commencement of those amendments.

114. On being given a telephone service users shall, in all cases, agree to be bound by the several provisions of the Regulations in force from time to time.

115. (1) In any case where it is desired or proposed to open a telephone exchange, and the provisions of the several parts of these Regulations do not appear to apply, full particulars should be furnished to the Deputy Postmaster-General as to—

(*a*) The number of persons who propose to join the exchange.

(*b*) The points to be connected, with radial distance from the post office.

(*c*) Information respecting any portion of the lines which can be erected by the applicants in conformity with the Regulations.

(*d*) Any further information required by the Deputy Postmaster-General.

(2) Upon receipt of the required information, the Postmaster-General will determine whether the exchange is to be opened, and, if so, under what conditions and rates.

XI.—AGRICULTURAL EDUCATION.

R. Sillett, Principal, Gippsland College, Sale.

When we consider the average yield of wheat and other cereals in our own country—from 8 to 10 bushels of wheat per acre and other cereals in proportion—and then notice the average yield in the old land—as high as 28 bushels of wheat per acre—we must wonder what cause is at the root of all, and are, perhaps, tempted to say that the differences of climate and of rainfall have got everything to do with it. No doubt these things account very largely for our small average yield, compared with that of Britain and other old world countries, yet there must be something else that helps to make the discrepancy. The want of fertility in our soil cannot account for the difference, as the soil compares favorably with that in most parts of the old world. Knowledge of how to treat the soil to the best advantage, and to supply the necessary manures and fertilizers will no doubt in time bridge over, to a great extent, the great discrepancy, and help us to get much better returns from our land, and this knowledge is to be acquired by agricultural education.

At the beginning of last century, the Black Isle, lying between Cromarty and Moray Firths, in the north-east of Scotland, was a barren stretch

of land, deemed incapable of improvement, and supporting, at most, only a few crofters. Mr. Middleton, a Northumbrian farmer, was allowed to take up a large portion of this country free of rent for the first few years, and at a small rental, 2s. 6d. per acre, for the rest of a nineteen years' lease. At the present time three of his sons farm the same land, paying about £3 per acre rent. The farms are models of improvement, and in spite of the drawbacks of remoteness from any large market and difficulty of transit, the sons seem to have less difficulty in finding the £3 per acre than the father had in finding 2s. 6d. What made the difference in the rental value of the land? Chiefly practical and scientific knowledge applied to farming.

How many of our young people do we see drifting from the farms to the large cities, leaving the healthiest, and, if carried out on proper lines, one of the best occupations of all time—that calling which provided Rome with Cincinnatus, twice the saviour of the Republic, and that occupation which a Roman Emperor preferred to the lofty but trying glories of his throne, leaving those pleasures of which the Roman poets, Virgil and Horace, and scores of poets since, have written and sung; that industry in which one may live and thrive without doing any harm to any competitor, but in which the more one produces only brings greater credit on himself, greater gain to his country, and more happiness to the street-bred folk, whom he helps to supply with cheaper food; that calling in which we may have leisure and opportunity to enjoy the seasons as they come and go. I think one of the main factors to hinder this continual drifting to the towns will be found in the teaching and spreading of the principles and practice of higher agricultural education. We live in an age whose characteristic is said to be thoroughness, and we belong to a race that prides itself in being thorough. It is this thoroughness which obtains the credit of placing us in the front ranks of progressive people. Judged by progress, made generally, we have no cause to be ashamed of our thoroughness. But for our thoroughness to be effective, we must notice things as they are, and reason and conclude therefrom. A century and a half covers the time between Black's investigations into the fertilizing properties of soot from the chimney, and Curie's discovery of radium, with all its immense possibilities. One hundred and fifty years ago the effects of nitrogen compounds on vegetation were not understood; now we are investigating the very origin of vegetable life. The science of chemistry is only one of the many branches of knowledge which the farmer must lay under contribution, if he is to make the best of his possibilities. Just as "the farmer feeds them all," so does he exact from all the sciences somewhat towards his own maintenance and progress, and no one, I hope, begrudges him what he gets. But the application of scientific principles to the great accumulation of applied sciences, which we call agriculture, although sure, makes but slow progress. This is due to two great factors —the conservatism of the farmer, and the expense of acquiring the requisite knowledge. Probably the financial difficulty would vanish if the other difficulty could be removed.

But it is against all natural laws to expect the farmer to be anything but conservative. Every man is conservative where his own occupation is concerned. It was a barber who made our first spinning machine. Had Arkwright been reared a cotton-spinner he would quite possibly have invented a machine for the manufacture of wigs. And we find that the improvements in applied science which we have to thank for our progress

have, in many instances, been due to the efforts of non-farmers. Now, every thinking farmer knows the benefits to be derived from a knowledge of a system of thorough scientific farming; but how is this knowledge to be acquired? On the ordinary farm it cannot be gained. In this age of progression, we must keep abreast of the times. Chiefly from the want of co-operation amongst farmers and from a somewhat supercilious contempt for theoretical farming, agricultural education has been neglected, and while the sum of £16,000 has been spent annually on Schools of Mines and of Arts, not the sum of £1,000 has yet been laid out in building an Agricultural High School. And when we consider that the products from the soil of Victoria reach a total of £20,000,000 per annum, while from all sources of mining they reach but £3,500,000, we certainly feel that agricultural education has been somewhat neglected. Good work has been done, and is being done, in State schools by Nature-study, observation work, and in some cases by the study of agriculture. These all trend in the right direction, and will bear good fruit in the future; yet how can the ordinary country teacher, with twenty-four different subjects, taught single-handed to eight different classes, be expected to be very enthusiastic on this one particular subject.

The Agricultural Department, by means of farmers' lectures and classes, dairying instruction to creamery and butter-factory managers, experimental plots, and in many other ways (especially one lately introduced by the present Director, who, by experimental fodder plots and silos, has striven to show how that dread scourge to northern herds, dry murrain, may be combated) is doing good work, but something more than all these is required to hasten knowledge in that science on which the welfare of the whole State, nay, of the whole world, depends, for, if the tillers of the soil were to strike *en masse*, what would the rest of the world do? We do not by any means begrudge the amounts allotted to the Schools of Mines and Arts, as we indeed recognise the many obligations we are under to the mining industry for its great benefits in the past, but when the glories of Ballarat and Bendigo form ancient history, and the wealth of Mount Morgan and of the Great Boulder grow dim in the grey vista of years, as in the first days when the "Gardener Adam" was driven from Eden, and bidden to till the ground, so till the last trump shall summon him from his tillage, shall the farmer and his work continue.

Hitherto, although the fees for instruction at Dookie Agricultural College have been very small—£25 per year, and a little additional charge for books, medical attendance, laundry work, &c.—for this sum agriculture, with all its scientific principles of botany, zoology, geology, besides viticulture, poultry farming, veterinary science, &c., has been taught. Many of the old pupils have been successful in obtaining positions of importance in this and other States, one being chief dairy expert in South Australia; another fills the post in London of Inspector of Victorian Produce; one is horticultural editor of a leading Melbourne weekly; another manager of an experimental State orchard in New South Wales; and one manager of an experimental farm in Queensland; several, including Mr. Rudduck, veterinary instructor, are veterinary surgeons, while in the recent examination for dairy supervisors, five of the twenty-two successful candidates were old Dookie students. Yet, notwithstanding all these benefits and the solid advantages to be obtained for his son and himself from the former's course at Dookie, the struggling farmer is debarred in many ways

from making use of these benefits. Not only must he find the money that would be required for fees, &c., needed to supply the necessities of his other children, but he would be doubly burdened by losing the services of that youth often of more use to him than a man. And so he plods along in his old way, sometimes envying his more fortunate brother, who has been able to make the most of the opportunity thus offered by Dookie, sometimes, it is feared, decrying the advantages of scientific farming in general, and Dookie in particular.

Now, since agriculture has been made a subject for a course at the University, in conjunction with Dookie, care should be exercised lest the practical part of agriculture should be left too much in the background. After the course at the University, one year of practical agriculture at the College has been prescribed. Surely this is barely sufficient time at practical work for a man to receive a diploma on; besides, would it not be much better to receive the first part of the training at a college where agriculture is in the ascendant than at the University, where it is not so. We are all agreed about the necessity of improving the general average of the grain yield, and thereby the farmers' and the country's wealth, and of hindering as much as possible the drift of the rural population to the metropolis, and large towns, and of placing our nation in the van with other progressive nations. Seeing that agriculture is in such an overwhelming degree the most important of all our industries, and is the mainstay of all our national and commercial prosperity, surely we are not seeking too much when we ask that one or two Agricultural High Schools shall be opened in populous farming centres on the same lines as the Continuation School in Melbourne, and on the basis proposed by the Director of Agriculture, saying that the Departments of Agriculture and Education take over the burden of expense until such time as the general community can appreciate the good work done. If, in addition to this, five scholarships for Dookie or Longerenong, were given by the Council of Agricultural Education, and five more by the Government, one through each group of the district societies, and these scholarships given annually and for a two years' course, not as now triennially and bearing a three years' course, not for excellence in scholarship only, but marks to be allowed also for experimental work done at home or at school or by some other proof to an inspector of schools that the boy has a predilection for agricultural pursuits, a lad whose parents are in somewhat straitened circumstances, would have a chance of graduating through State school, Dookie College, and the University, and thus a comprehensive system of agricultural education would be complete. These scholarships should be, as much as possible, confined to the sons of struggling farmers.

And further, as aids to awaken and sustain interest in agricultural and rural pursuits, and also as a means of real benefit, let organized visits to Dookie and Longerenong, of farmers and farmers' sons, and where practicable of elder school lads under the supervision of their teachers, be made at reduced railway fares in the same manner as students of Schools of Mines are allowed to travel, or let even greater facilities be allowed, as the distances would, in many cases, be much greater. Now we know we have the sympathy of the Directors of Agriculture and Education in this matter of higher agricultural education, and we believe we have that of the Ministers of these two most important Departments; and, since the Premier declared at Brighton just

the other day that he meant to advance agricultural education by all means in his power, let us hope that our modest wishes, as here so feebly set forth, may, ere long, end in happy fruition.

God Speed the Plough.

XII.—HEREDITY IN STOCK-BREEDING.

Address by S. S. Cameron, M.R.C.V.S., Chief Veterinary Officer.

On the occasion of the Convention at Horsham last year, I read a paper of considerable length, and I feel quite assured that, if one's duties permitted it, a Convention of this kind, which might be regarded as the High Parliament of agriculturists, should be paid the compliment of that careful preparation which the writing of a paper involves. I did not write a paper on this occasion, partly because of the calls made on my time by the coming into force of the new Milk and Dairy Supervision Act, but particularly for the reason that at the Horsham Convention there was distinct evidence of the fact that more value was placed upon the exposition of any subject which happened to be brought up by members in the discussion which followed. Consequently, when I was asked by your secretary to give an address at this Convention on the subject of "Stock matters generally," I was rather delighted at the wide scope given. Later on I was asked to name a subject, and, while I named "Heredity in Stock," I still felt that more good would result from an exposition of any subject in connexion with diseases in stock which any of the audience might wish to have expounded. And I am confirmed in this opinion by the fact that since my arrival in Sale a request has been made to me that I should say something during the proceedings of the Convention on the subject of "Cripples," that disease which is so widespread, and which is causing such heavy mortality amongst the dairy cattle of the country. However, a short address on the subject of "Heredity in Stock-breeding" will serve as an introduction.

One of the things I had in mind in deciding on this subject was to attract attention to the question of the unsoundness or soundness of the horse stock of the State, and a few general remarks on the laws of heredity will quickly bring me to that point.

One of the most glib and best-known laws of heredity is that "like produces like," but as it is usually accepted or interpreted that statement or law is a great error. Like only produces like when all the factors and conditions are exactly similar. How often in practical breeding operations does this exact similarity obtain? Very seldom, if ever. It therefore happens that the progeny of two animals when mated together always shows some dissimilarity to the parents. The colt of one year shows some dissimilarity to the filly of the following year. No human beings—no two brothers or sisters—are alike. This variation depends on many things—some unknown, others known, such as the surroundings, food supply and

the like. You may take it then, and those who have had practical experience of breeding will bear me out in the statement, that the law of variation obtains much more in practical breeding operations than the law that like produces like. The practical application of that statement is that animals which diverge widely in form, colour, or characteristics should not be brought together for breeding purposes if unexpected results are to be avoided. An illustration will serve to make my meaning more clear. It is very much like two converging streams of water. If they are flowing almost parallel to each other, and are equal in volume and rapidity of flow, they unite harmoniously; but if the volume and rapidity of flow are unlike, and the streams unite at a sharp angle, then all sorts of counter-currents and unexpected results happen, and so it is with bringing together, for breeding purposes, animals which are unlike. A safe method is to put a like dam to a like sire, and then you have some chance of not being disappointed. Thoroughbred when mated with thoroughbred produces thoroughbred; Clydesdale when mated with Clydesdale produces Clydesdale; but to mate a half-bred mare, whose breeding history you do not know, with a thoroughbred sire, is to place yourself in the position of not knowing what you are likely to get. The game is still more uncertain when both sire and dam are crossbred, and particularly when their breeding history is not known. It is on account of this lack of knowledge of the breeding history of parents that great disappointment and unexpected results ensue. It is not so much a question either of the immediate parents being apparently suitable mates, through their similarity, but that such similarity is due to their having been bred on similar lines—a mere accidental similarity or apparent suitability is not enough.

I have mentioned that variations occur on account of differences and conditions either in sire or dam, in surroundings, food, or other governing factors at the time breeding operations are being carried on. Even slight variations in the progeny continued through successive generations result in the variations or changes becoming permanent, and advantage has been taken of the fact that variations do become so fixed to effect improvement in breeding of horse stock. Any variation for the better is noted, and an attempt is made in mating to perpetuate the advantageous variation, and so fix it. As the law of variation has been taken advantage of by shrewd breeders to improve and develop good points, so it should be taken advantage of to avoid defects. This brings me to the subject of defects. I am not going to refer to those defects of form which are a matter of opinion—for example, as the shape of a horse's head, his length of neck, his width of loin, his breadth of hips, or other like matters of conformation, opinions on which are largely based on the judgment of experienced men from time immemorial. I am going to refer particularly to those defects of conformation which are handed down from the parents to the offspring, and which when existing in an animal constitute in that animal a predisposition to unsoundness, or a predisposing cause of a disease which constitutes unsoundness. Strictly speaking, there is no such thing as hereditary unsoundness. The tendency at the present time in scientific circles is to interpret the word inheritance as meaning the possession of the quality inherited at the time the animal is born, and in that strictly scientific sense few, if any, unsoundnesses are inherited. No one, for instance, has seen a horse born with a ringbone, sidebone, curb, or, except in odd

instances perhaps, any of the defects which constitute unsoundness in horseflesh. This I desire to particularly impress: that it is not the disease itself, it is not the enlargement of joint, nor the inflammation preceding such enlargement, which is inherited. But what is inherited is that conformation—of the pastern, say—which on the application of a certain cause will result in the horse developing a ringbone. It is the short, upright pastern which is particularly prone to the development of ringbone, that is inherited. This conformation of pastern tends to accentuation of concussion when the horse is put to work: and inordinate concussion results in the formation of a ringbone, with its accompanying pain, inflammation, and lameness. Similarly with regard to breeding from a horse that is tied in below the hock. A horse having that type of hock, with a good breadth from the front to the point of the hock, but narrow at the junction of the hock with the cannon, is liable to develop a curb at any time on the incidence of extra strain on the part. A sire and dam possessing this defect of conformation, predisposing to curb, will have progeny possessing the defect. In a great number of cases, if the sire alone possesses the defect, the progeny will have the defect, particularly if the sire happens to be an animal which possesses in a great measure that quality known as prepotency. I have said that a sire affected with ringbone will have progeny which is not so affected until the progeny is subjected to the same conditions of work which produced the ringbone in the sire. It is when the progeny reaches the age of three or four years, when it is put to hard work, particularly on hard roads, that the ill-effects of the concussion will result in that inflammation of the pastern from which a ringbone is developed. Similarly in the case of a sickle-hocked horse. If such a horse be not subjected to any excessive strain he will possibly never develop a curb, but if, on the other hand, a horse with that weak conformation below the hock be subjected to some special strain, as when the horse is jumping a fence, or, in the case of a draught horse, when a heavy strain is occasioned in drawing a load up a hill, then the weakness will manifest itself, and the sinews binding the hock bones together at the back will become strained, and the resulting enlargement is a curb. While disease and unsoundness are not in themselves inherited, but only the tendency or predisposition to the development of disease is inherited, I want to emphasize the point that for all practical purposes it amounts to the same thing. It is the same with tuberculosis in cattle. The disease itself is not inherited. There have been perhaps one or two isolated cases recorded in which calves have been born with tuberculosis. These records may perhaps be questioned, and in any case they are not of sufficient importance to upset the general statement that tuberculosis is not inherited. It is the vulnerability to the disease, the lack of resistance to the invasion of the germ causing the disease, that is born with and is possessed by the progeny.

I would like to say here that, as practical stock-breeders, as men whose success in life depends on the kind of animal you produce, you should pay most regard to the production of stock which is of the highest value. I do not wish to make any wild or alarming statements as to the prevalence of unsoundness in the horses of this State. But I do know that the value of the horse-breeding industry is largely decreased by the unsoundness of horses that would otherwise be saleable and exportable. No Indian buyer will touch a horse with the slightest blemish approaching an unsoundness. No shrewd local buyer will purchase at anything like

full price an animal with such defects. Hence it is, in large measure at all events, that horse-breeding is often unprofitable. When through the existence of unsoundness or defects that promote unsoundness less than 50 per cent. of the sound value is realized for young stock the unprofitable nature of the undertaking is apparent.

The question of soundness in brood mares is, of course, of importance, but I know that in actual practical affairs a farmer cannot very often afford to reject for breeding purposes a mare that happens to be unsound. While not actually advocating breeding from unsound mares, I wish to put it strongly that the harm is infinitesimal compared with breeding from unsound stallions. Only one foal is prejudiced each year, whereas in the case of an unsound stallion a good proportion of the whole crop of foals in a district may turn out useless. Consequently, in the majority of cases the defects in young stock are produced by the stallions, and I think that some steps should be taken whereby it might be warranted that a horse standing for breeding purposes should be sound. I go further, and say it should be the duty of the agricultural societies to see that they do not give prizes to unsound horses, and I may tell you that so long as I remain in the Government service so long will my endeavours be directed towards seeing that the money paid by the Government as a grant to agricultural societies will not be given to the encouragement of unsound horses. Many breeders have no other guide as to the excellence of a horse than the records of show prizes, and so long as such prizes may be won by unsound animals it is unfair to blame owners of mares for patronizing them.

The matter of the rejection, so far as prize money is concerned, of unsound horses at shows is a question that can be dealt with in various ways, but it has struck me that one of the ways in which sound stallions could be assured to a district is by agricultural societies arranging for the holding of a parade prior to the commencement of the breeding season, at which all stallions it was proposed to stand in the district that season might be examined for soundness. Although I have no authority for saying so, I believe that if representations were made in the proper quarter arrangements might be made whereby the Department of Agriculture would undertake the examination of stallions at such parades free of cost, and issue a Government certificate of soundness in respect of all animals found free from hereditary or transmissible unsoundness. Such a Government certificate might be termed, and would be considered, the "hall mark" of soundness in breeding stock. It would then be left to the people of the district to select the "hall-marked" stallions or those which were not "hall-marked." At all events, the breeders would then have only themselves to blame for the ultimate loss and failure if they deliberately chose to breed from other than guaranteed sound animals. If this suggestion is considered to be of any value it might be worth while to pass a resolution with the object of bringing it about.

Considerable debate followed on Mr. Cameron's address, and at a later session of the Chamber the following resolution, proposed by Mr. O'Connor (Yarram), was carried unanimously:—

That it be a recommendation of the Chamber of Agriculture to the Minister of Agriculture to arrange, on the voluntary request of any Agricultural Society or Parade Council, for the free examination for soundness of stallions standing for public service by approved veterinary experts, and for the granting of Government certificates of soundness."

In response to the action of the Chamber of Agriculture, the Minister of Agriculture (Hon. Geo. Swinburne, M.L.A.) has decided to adopt the suggestion embodied in the above resolution. The Department of Agriculture will, on the request of Agricultural Societies or Parade Committees, make the necessary arrangements for veterinary inspection at all shows and stallion parades, and for the issue of a Government certificate of soundness to all animals found free from hereditary unsoundness at the time of examination. Applications should be made to the Secretary for Agriculture, Melbourne.—Editor.

XIII.—CRIPPLES IN CATTLE.

Address by S. S. Cameron, M.R.C.V.S., Chief Veterinary Officer.

With regard to the subject of cripples in cattle, I wish at the outset to say that, when I have finished, I will be willing to plead guilty to a charge of having been theoretical, because as a matter of fact our present state of knowledge of the subject is so nebulous that there is nothing of a really scientific or proven character to expound to you. In the first place, I should perhaps say that under the name of "Cripples" in different parts of this State there are included either a number of different diseases, or else different manifestations of the same disease. In some parts a disease which, after its first stages, is manifested by an alteration in the character of the bones, is called cripples. In other districts a disease which, in its later stages, is associated with inflammation of the feet, somewhat identical with founder or laminitis in horses, is known locally as cripples. Then there are diseases which are known by the name of the district. For instance, the Winton disease is closely allied to the disease known in other parts as cripples. The disease in the Western district, known as Yambuk disease, is apparently a form of the same trouble.

Generally speaking, the disease is associated with that very common condition in dairy cattle called impaction. Another common symptom, in addition to impaction and unthriftiness, is loss of proper co-ordination of movement. An impression prevails that the impaction is caused by the dryness or non-succulence of feed, and is in turn the cause of the other derangements associated with the disease. While that may be so in some cases, it is very difficult to account for the subsequent symptoms on the supposition that dry food alone is the cause. For instance, shortly after the disease attacks an animal, there are manifested a number of paralytic symptoms, such as loss of power to swallow, and loss of the power of locomotion. As a matter of fact, there is associated with impaction a paralysis of certain nerves, and in my opinion this paralysis is the cause of the impaction, and not the result.

A short anatomical explanation will make my meaning more clear, and will enable you to understand in some degree the part played by nerve derangement in this disease. All animals have what are known as the cranial nerves. There are 12 pairs of these, arising from the base of the brain, and they are distributed to the anterior part of the body. They

are named numerically from one to twelve. The first (olfactory) is the nerve that has to do with the special sense of smell; the second (optic), with the sense of sight; the third controls the muscles of the eye-ball; the fourth supplies one particular eye-ball muscle; the fifth is a large one distributed throughout the head, and controls the muscles of mastication; the sixth goes to a muscle of the ear; the seventh controls the muscles of expression—the eyes, ears, nostrils, and lips; the eighth is specially concerned with the function of hearing; the ninth supplies the pharynx, and promotes the function of swallowing; the tenth is the pneumo-gastric nerve, which has three important functions — it supplies the lungs, and accelerates respiration, it steadies the action of the heart, and it is the motor nerve of the muscular walls of the stomachs; the eleventh has to do with the muscles of the neck; and the twelfth supplies the root of the tongue with nerve power. Now, in cripples there is a paralysis of all those parts, organs, and functions, controlled by two only of the cranial nerves—the ninth and tenth. In the case of Yambuk and Winton diseases, such paralysis is the most marked feature. It is true that the spinal nerves must be affected in some degree to account for the unsteady gait and partial paralysis of the hind-quarters; but with this exception every function of the body controlled by nerves other than the ninth and tenth cranials is performed normally in this disease; on the other hand, every function controlled by these nerves is paralysed. The inability to swallow, and the hanging out of the tongue in the later stages, is due to paralysis of the ninth cranial nerve. More marked still is the loss of function of those parts and organs that are controlled by the tenth cranial nerve, the pneumo-gastric. When this nerve is acting properly, it keeps the action of the lungs up to proper pitch. In Winton disease, which may be considered the most serious manifestation of cripples, the respirations are lowered because of the fact that the pneumo-gastric nerve is more or less paralysed. The same nerve has a steady or regulating effect on the movements of the heart, and when it is cut for experimental purposes, the heart is caused to beat very rapidly. In Winton disease, there is an increase in rapidity of the action of the heart, along with the lowering of respiration—a most unusual combination of symptoms pointing plainly to the fact that the one nerve is responsible. It is also one function of this nerve to stimulate the muscular walls of the stomach, and to bring about that movement of the stomach and churning of the food which goes on naturally. In Winton disease, there is no movement of the stomach at all. As the animal eats the food simply lies there, without being digested or moved on, and the stomachs become impacted. Even the gall bladder, which is supplied by terminal filaments of the tenth nerve, is also paralysed, and unable to empty its contents, so that it is always found full and distended with bile after death. This all points to the same condition of paralysis or loss of power of the pneumo-gastric nerve. The remainder of the alimentary canal beyond the stomachs—the intestines—which depend for their action on other nerves, continue to act normally, as shown by the fact that they are always found empty on *post-mortem* examination. The contrast between the "deadness" of the stomach and the normality of the intestines was plainly demonstrated during an experiment I conducted. I opened up a cow in the flank, and found that the stomach was completely without movement, yet through the same opening I hauled out a quantity of the intestines, and found they possessed the same motion as ordinarily—the normal peristaltic motion. As I have said, a *post-mortem*

examination always shows the bowels empty and the stomach full, proving that after the paralysis of the stomach started the function of the intestines has continued.

If my theory is correct—and the conclusions seem to me to be the logical ones to be drawn from the facts—then it may be said that the pathology of Winton disease form of cripples is fairly clear; but as to the causation of it we are in the dark. In this connexion, and as indicating a possible channel for the entrance of infection into the brain, I wish to mention a further original observation of mine, made about two years ago. During a series of *post-mortem* examinations, in addition to the appearances usually described, I found the nasal mucous membrane enormously engorged with blood. The engorgement extended back to the bones at the base of the cranium, and its extent bore some relationship to the severity of the disease. The more acute the case, the greater and more extensive was the engorgement, while in milder long-standing cases the engorgement was less pronounced and extensive. I do not know that this observation will turn out at all important, but it points to the possibility of the brain being inoculated with something through the nostrils. It has been previously suggested that the disease might be a form of mycotic poisoning, and it is quite feasible that during the late summer months there is something in the shape of a rust or fungus or mould which develops on ripe grasses, somewhat in the nature of rust on wheat or ergot on rye grass. The *post-mortem* observation I have just now announced may go to show that when the animal is pasturing it inhales this fungus, which reaches the brain by means of the nasal chamber, and exercises a selective and paralysing effect on the ninth and tenth nerves.

Another explanation I may advance as to the causation of the disease is that on account of the non-succulence of the herbage, constipation is brought about, and allows of the formation of an intestinal toxin or poison. The toxin is absorbed into the blood, and poisons the nerve centres. This idea squares with our knowledge of the causation of convulsions in children, which are now thought to be brought about by the formation of toxic material in the intestines of the child.

In conclusion, it will almost be superfluous of me to observe that investigations need to be made in the direction of finding out whether the trouble is caused by a germ, an alkaloid or fungoid poison, or in what other way. At the present time, it seems likely that something is to be done in the way of providing a research institute for the investigation of the diseases of animals, and when the project is brought before you, I will ask you, as representatives of the agricultural and live stock interests of the State, to support the movement. I think that it is only right the wealthy stock-owners should be appealed to. Instead of looking wholly to the Government, they should be prepared to supplement the efforts of the Government with some financial assistance. There is no country in the world that has more need for such an institute. Animals are becoming more and more valuable—so much so that it might be said that the live stock of the country constitutes its national life-blood.

DISCUSSION.

In reply to questions, Mr. Cameron said that as to the question of infectivity he was not prepared to speak at present. If the theory of the

mould poisoning turned out to be correct the disease might be considered infectious. The disease most frequently occurred on kangaroo grass country when the grass was ripe and dry. It was either a question of the dry character of the grass or a question of the grass being affected with smut or rust. One outstanding fact was that cripples never, or very seldom, occurred where the animals were fed on succulent herbage. In crippley country during the late summer months cripples could be prevented by giving succulent hand feed or bran. The best advice he could give was that, in carrying dairy stock during the late summer months, particularly on poor country, the natural dry feed must be supplemented with maize, amber cane, the different sorghums, millet, roots, or something of the kind. If these were not available, bran and treacle should be used. In some manifestations of the disease he would be inclined to say that cows suffered from cripples, although there was no impaction of the stomach, especially in the manifestations associated with rickets. In cases of so-called cripples, which lasted over a long time, during which the animal eats well, the stomach acts, and paralysis did not occur to the same degree. It was a fact that the disease occurred in all parts of the State, although there might be some special patches on which the disease did not occur. The disease was more or less widespread. He had very little sympathy with the theory of soil exhaustion. He also questioned whether the alleged deficiency of phosphates in the soil had very much to do with it.

Treatment of the associated impaction was not successful in all cases. In the first place a laxative was required, but if the paralysis was thoroughly set up it would not have much effect. The laxative should consist of the following:—1 lb. Epsom salts, 2 oz. powdered jalap, ½ oz. ginger, and ½ lb. treacle for a cow. Later on this might be followed by powders to stimulate the appetite. The powder should be made up with ½ oz. each of carbonate of ammonia, ginger, and gentian, given in cold gruel twice a day, in the early stages at all events.

The whole question was one of succulent food at the end of summer, and Dr. Cherry had been hammering away at this point for some years. The silo provided this food for the dry portion of the year, and he hoped that all the farms upon which they were erected would have definite results.

Mr. Power said it would strengthen the hands of the Government if a resolution were passed supporting the idea of a veterinary institute for research. The Government should provide funds to enable examinations to be made into the trouble caused by cripples, which was so widespread. He moved—

That this Conference highly approves of the suggestion that funds be provided to enable research to be made into the cause of cripples and stock diseases generally, and the best remedies for such.

Mr. Horstmann seconded the motion, which was carried.

On the motion of Mr. O'Connor, seconded by Mr. Kennedy, the following resolution also was unanimously agreed to:—

That the Chamber of Agriculture make representations to the Government heartily supporting the Premier's announced proposal for the establishment of a combined Veterinary Research Institute and University Veterinary School, and conveying the assurance that such an institute and school is likely to be of the utmost value to the dairying and live stock interests of the State.

MODERN BEE FARMING.

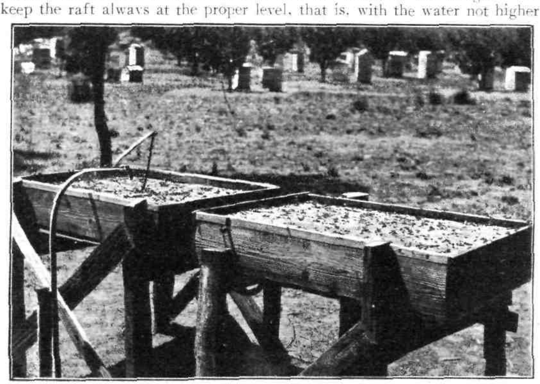
R. Beuhne, President Victorian Apiarists' Association.

PART V.—WATER FOR BEES.

Few beekeepers are aware what amount of water is required by a colony of bees during the summer months, and how important it is that a permanent supply should be available within a reasonably short distance of an apiary. As a general rule, bees are left to themselves to get their supply of water wherever they can. There is usually a natural watercourse, dam, or waterhole somewhere in the neighbourhood, and if permanent and within a few hundred yards of the apiary, such sources answer well enough. When, however, water is not permanently available within a quarter of a mile, it is greatly to the advantage of the apiarist to provide an artificial supply as near the apiary as convenient. I do not think that the time occupied by the bees in carrying water over a longer distance need be seriously considered, but the greater liability of being caught by birds and insects, blown down during strong winds, or caught in rain-squalls during the longer journey is a serious matter. At the margins of dams and water-holes hundreds of bees are often destroyed within a few minutes by cattle or horses stamping them into the mud or swamping them through the plunging of the animals into the water. Where many bees are kept, and the water supply is limited, they become a nuisance to stock, and sometimes a source of ill-feeling between neighbours in consequence. Bees are also very annoying about the apiarist's own home, round water-taps, tanks, and the drinking dishes of poultry, when the weather is hot, and any other supply of water rather far from the apiary. The writer was confronted with all the troubles enumerated when first establishing his apiary in its present location; an automatic artificial supply close to the apiary has overcome these difficulties, and has now been working continuously for eight years without a hitch.

The water is obtained from the roof of the honey house and stored in two tanks of 1,000 gallons each. An iron water-pipe, laid underground (18 inches deep) so as to keep it cool in summer, conducts the water to the drinking troughs, which are at a distance of about 100 feet from the building, and the same distance from the nearest hives. This distance is necessary, otherwise the bees, when flying to and from the water, interfere with work in the apiary, and also cause confusion at swarming time. There are two drinking troughs; they are placed on a stand at a height of 3 feet from the ground, in order to prevent poultry going to them, and to keep drifting leaves and other material out as much as possible. Each trough measures 36 inches x 24 inches inside, with a depth of 6 inches, and consists of a frame made of 6 x $\frac{7}{8}$ white Baltic flooring boards, with a bottom of 6 x $\frac{1}{2}$ lining boards. It is lined with plain galvanized iron, No. 26 gauge, neatly fitted inside the wooden casing, to which it is secured at the top with fine tacks. It is better to have two or even three of such troughs instead of a large one of the same surface area as the two or three combined. If only one large trough is used the bees are too much concentrated, and a good deal of fighting and stinging takes place occasionally. It is, therefore, better to have several troughs a little distance apart, and if they are placed on the same level and connected by means of a piece of garden hose attached to a

stud at the bottom of each, one stand pipe, with automatic tap, will supply them all. On the top of each trough floats a raft, upon which the bees alight to drink, and it is so constructed that they cannot drown, and even dead bees cannot drop into the water and thus pollute it. The raft is made of slats of ½-in. lining boards, 35⅞ inches long, 15-16th inch wide, and ½ inch thick. The edges on the upper side are planed away at an angle of 45 degrees, so that when the slats are placed side by side they form V-shaped gutters, with an opening 1-16 inch wide at the bottom. Twenty-four of these slats are nailed on to three cross-pieces of ⅞-in. flooring board 23½ inches long and 2 inches wide, in such a way that the thin bottom edges of the slats are 1-15 inch apart. The raft is then fitted into the trough and dressed till a space of not more than ⅛ inch remains all around between the raft and the lining of the trough. To keep the raft always at the proper level, that is, with the water not higher



DRINKING TROUGHS FOR BEES.

than about ⅛ inch between the slats, air-cushions are fastened underneath the raft, one at each end. They are made of light zinc, such as the lining of piano or drapery cases. Fold a piece of this material, cut the correct dimensions, over a piece of wood 35 inches x 5 inches x 1 inch, solder the joints, and, after withdrawing the board, also the end. It may be tested as to being air-tight by pressing it under water to see whether air-bubbles escape; if so, there is a leak which has to be re-soldered. In soldering zinc, raw spirits of salt, diluted somewhat with water, should be used, not killed spirits (chloride of zinc); this rule also applies to galvanized iron. The solder-iron should be clean, well faced with solder, and only just hot enough to melt the solder, but not the zinc; this is only possible if the solder is of good quality. If the air-cushions raise the raft too high at first the latter should be weighted down to the proper level by means of small stones evenly distributed, and as the wood becomes saturated with water they may be removed as required. The raft of the trough, which is under the stand-pipe, has an upright iron rod

pivoted to it in the centre. This rod connects by means of a hinge-joint with a lever fastened to the head of the water tap, which is screwed into the stand-pipe, so that the cone of the tap is in a horizontal position, and, therefore, lowering the lever will open the tap, and raising close it. No dimensions for rod and lever can be given, as these depend upon the height of the tap above the raft, its distance from the centre of it, and the size and passageway of the tap itself. The measurements and the angle of bend in the tap lever can, however, be easily ascertained. The tap should be completely shut when the raft is within an inch of the top of the trough, but should begin to run as soon as the raft sinks and draws down the lever, when the water level is reduced by the bees drinking.

The accompanying illustration will give a general idea of the arrangement. The troughs shown are of the dimensions stated, and give drinking accommodation for 150 colonies. When the season is very hot and dry, and the colonies strong, a third trough is added by means of a hose connexion, as stated before. The roof of the honey house, with a ground measurement of 21 feet by 18, collects with a rainfall of 20 inches sufficient water for the bees and the ordinary requirement of extracting, &c.

There are many well-timbered areas in Northern Victoria where beekeeping could be carried on successfully, but which remain vacant owing to the absence of a water supply for the bees. Every beekeeper requires a dwelling and a building for the requirements of his business; if these are constructed in time to get a supply of water for the following season, and if the roof area is sufficient to give the required quantity with the rainfall of the locality selected, there is nothing to prevent some of the waterless, but for beekeeping, otherwise excellent country being utilized.

STATE SCHOOLS' EXHIBITION.

The great advance which nature study and kindred subjects have recently made was fully exemplified at the State Schools Exhibition, held in Melbourne, from the 5th to 22nd September. The exhibition, at which the total attendances numbered 300,000, was a pronounced success both from the educational and spectacular stand-point. In several instances, notably Mortlake and Naringal, splendid specimens of agricultural produce, the results of school farming, were exhibited; these products, together with particulars relative to manures, soils, grasses, &c., illustrated how thorough had been the study of agriculture. The Wy Yung exhibits also bore striking evidence of the extent that up-to-date education is playing in the development of agricultural knowledge. This knowledge must undoubtedly have a beneficial effect both on the individual and on the community of the State generally. The exhibition has clearly shown that the teachers of the Victorian Department of Education are deserving of every encouragement in their efforts to develop the intelligence of the rising generation.

A. T. S.

GARDEN NOTES.

J. Cronin, Inspector, Vegetation Diseases Act.

The Narcissus.

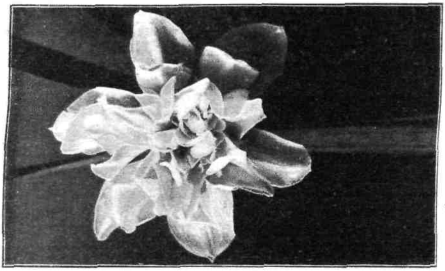
Narcissus—which includes daffodil, jonquil, &c.—is a genus of hardy bulbous plants, most of the species of which are natives of Southern Europe. A few of the original types are still cultivated in gardens, but most of the fine varieties now grown have been produced from seed. The various species have been hybridized, chiefly by English cultivators, who have produced most of the fine kinds in cultivation, and have evolved types distinct and superior to the original.

The accepted classification of the narcissus is based on the length of the cup, or tube, of the blossom, as compared with the segments of the perianth. Narcissi are divided into three main divisions or groups, viz.:—(1) Magni-coronata, or large crowns, commonly termed trumpet daffodils, in which the trumpet is as long, or longer, than the perianth; (2) Medii-coronata, or medium crowns, in which the crowns are about half as long as the sepals; (3) and Parvi-coronata, or small crowns, in which the cup is very small compared with the perianth. In this latter class are included the Tazetta, or bunch-flowered narcissi, commonly, but erroneously, called jonquils. Each main division is again divided into sections, that denote some particular arrangement of colour or form of crown. In the first division the sections are:—The major type, in which the flowers are yellow; bi-colour, the perianth of which is white and the tube yellow; white or sulphur-coloured, selfs; and the bulbocodium, or hoop-petticoat narcissi, in which the perianth is insignificant. The second division includes the *incomparabilis* group; Barrii, hybrids between *incomparabilis* and *poeticus*; Leedsii, hybrids from *montanus* and *poeticus*; Nelsonii; Humeii; and other hybrids; and *campernelli*, juncifolius, and the true jonquil, *Narcissus jonquila*. The third division includes the *poeticus*; Burbidgeii hybrids; and the tazetta or polyanthus groups.

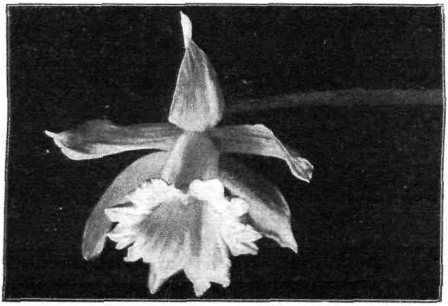
Narcissi are undoubtedly the finest of our winter and spring flowering plants, and, being of easy culture, are deservedly popular and successfully cultivated in all parts of the State. The forms or types are varied, although the range of colour is limited. A number of varieties are much earlier than the majority, while a few of the best kinds are later in their blooming. Late-flowering varieties are not recommended for the earlier and hotter districts, as the blooms are not capable of enduring hot sun or wind. A number of growers are now producing large quantities of flowers for sale for the local and Inter-State markets, and the produce earns many thousands of pounds per annum to those cultivators. In the cooler districts there is probably a fair opening for the culture of late varieties to succeed in the markets those grown in the metropolitan district.

SOIL AND CULTURE.

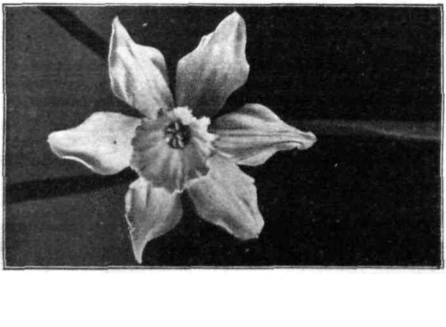
The most suitable soil for narcissi is a light friable loam. They will, however, grow and bloom well in any well-drained, fair, garden soil. The addition of fresh stable manure to the soil in the proximity of the bulbs is most injurious, and should be avoided. Well-rotted stable manure is beneficial when deeply worked into the soil well below the bulbs, but the best manure for all narcissi is a mixture of equal parts coarse bone meal



"GOLDEN PHOENIX,"
DOUBLE-FLOWERED TYPE.

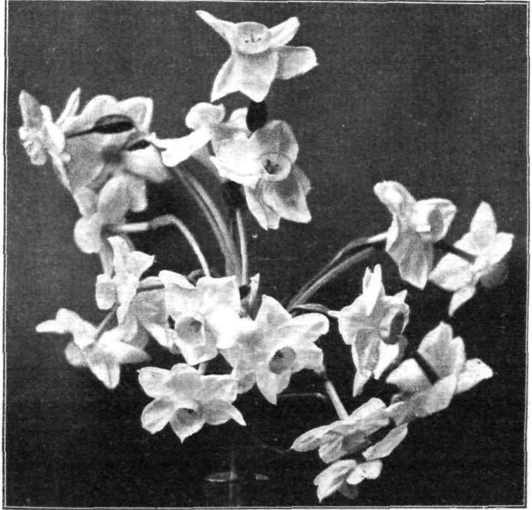


"M. J. BERKELEY,"
LARGE TRUMPET SECTION.



"MINNIE HUME,"
MEDIUM TRUMPET SECTION.

and superphosphate, applied at rate of about 1 lb. to the square yard. In cool soil this manuring is quite sufficient, but in hot, sandy soils the addition of well-rotted cow manure to the bottom of the bed or patch is of special value, on account of its coolness and moisture-retaining properties. The bulbs are most satisfactory when planted in special beds, although they will succeed and often produce exceptional blooms when grown in borders among other plants. The advantage of the bed system is that the bulbs are not watered artificially in the resting period as is generally the case when they are grown in borders of mixed plants. In preparing soil for the reception of bulbs, the bed or patch should be worked



"GRAND MONARQUE," TAZETTA OR BUNCH-FLOWERED TYPE.

to a depth of about 18 inches, the manure applied to the bottom 9 inches, and the soil firmly trodden before planting. Bulbs of the majority of varieties should be planted about 3 inches in depth, very large bulbs an inch deeper, and bulbs of small and weakly-growing varieties an inch less. The bulbs should be planted from 4 to 6 inches apart, and may be allowed to remain undisturbed for three years, when they should be lifted, divided, and replanted. The bulbs are ready to lift when the tops turn yellow, and should be replanted at once, if possible. Otherwise they should be dried and stored in a cool place till the latter end of March at latest. After the flowering period is over, the bulbs should not, as is usual, be allowed to suffer from want of cultivation. The longer the "grass" is kept growing the better the blooming in the next season.

The varieties worthy of cultivation are as follow:—Long trumpet section—Yellow—Ard Righ, Maximus, Henry Irving, M. J. Berkeley, Glory of Leiden, Johnstonii Queen of Spain, Thomas Moore, Emperor, Golden Spur, King Alfred, Bicolor, Empress, Princeps (the popular and cheap market daffodil), Victoria, Madame Plemp, Grandis (late), Ada Brooke. White—*Albicans, cernuus pulcher, tortuosus, pallidus præcox*, Wm. Goldring, Madame de Graaf. Medium trumpet—Sir Watkin, Beauty, Frank Miles, Gloria Mundi, Gwyther, Barrii Conspicuous, Princess Mary, Minnie Hume, Duchess of Brabant, Amabilis, Katherine Spurrell, William Wilks, *jonquila, odorus*. Small crowns—Burbidgeii, John Bain, Almira, Falstaff, *poeticus ornatus, biflorus*. Double flowered—Van Sion or *telemonius plenus*, Hale's Silver and Gold, Orange Phœnix, Sulphur Phœnix, Golden Phœnix. Tazetta or bunch-flowered — Grand Monarque, Grand Soleil d'Or, Grand Primo, Paper White (the earliest market variety), Her Majesty, The Pearl, Staten General, Queen of the Netherlands.

Flower Garden.

If not already done, the most important work is the reduction of the rough surface left after digging in winter. No time should be lost, or the moisture in the soil will evaporate, and the work made more difficult later. Sandy soils can be worked at almost any time, but heavy loams are best attacked when in a half dry condition. The surface should be broken down as fine as possible, and if water is scarce a mulch applied early.

Chrysanthemums intended for exhibition should be planted this month. Early varieties are retarded somewhat in their time of blooming when planted a fortnight later than mid-season kinds, while late varieties should be planted earliest, and, if possible, in a bed by themselves. Beginners need not be dismayed at the apparent skill and knowledge required, as suggested by writers to horticultural papers on chrysanthemum culture. A fair soil, well manured and drained, with attention to cultivation, staking, and disbudding is all that is needed to produce fine flowers. A lot that is written of the need to save certain buds on a certain date does not apply generally. Under conditions of perfect control, as when plants are grown in pots and flowered under glass, such points may be of importance, but under our variable outdoor conditions *they are not*. Special notes on chrysanthemum culture appeared in the June issue of this *Journal*.

Surplus and misplaced shoots of roses should be removed as they appear, and where fine blooms are desired the buds thinned. Newly-planted roses should be mulched, and a little care taken in the arrangement of the shoots, especially on standard specimens. An occasional dusting with flowers of sulphur will prevent mildew.

Carnations will be making their flowering growths, and will need attention in thinning and tying to stakes. Admission of light and air, and a more plentiful supply of nourishment for the shoots retained, are secured by thinning excessive growths on plants generally.

In reply to a query *re* striking daphne cuttings, it is not at all a certainty that cuttings of daphne will root except under conditions known to a few nurserymen only. Some of our most successful propagators often fail to strike cuttings of this plant. They require some shelter, such as a cold frame or bell glass, and regular attention for a long time. Lady cultivators manage occasionally to strike them, but the percentage rooted is very small. Cuttings of half-ripened wood, 4 inches in length, should be taken in early autumn and inserted in well-drained pots, filled with sandy peat, if available. These should be watered and placed under a

glass protection that will afford light and maintain a cool, moist atmosphere. Only sufficient moisture should be given to keep the cuttings fresh, and the glass should be wiped free from moisture each morning. Daphnes root readily from layers, tongued and inserted in sandy soil in spring.

Salvia "Bonfire" and other bedding plants may be planted.

Kitchen Garden.

Thinning and weeding growing crops, sowing seeds of such vegetables as well be required for use in autumn, planting out from former sowings, and, where necessary, watering young transplanted subjects are the most important items.

Tomatoes and other plants raised in frames should be planted out. In late districts protection against frost must be provided. For small gardens, bush marrow is the most suitable of that class of vegetable. The plants require little room, and produce several fruits if attended to with water and cultivation. Seeds of peas and French beans are better sown in drills, to allow the soil to be worked up to the plants later.

POTATO-GROWING AT WHITFIELD.

The following particulars of a crop of potatoes, grown on one of the Whitfield Closer Settlement blocks (Mr. A. Maconochie's), will show what can be done in that district with potatoes cultivated on up-to-date methods in soil, if anything, below the average quality of the flats on the estate.

Soil.—Light, red, sandy loam, shallow, with gravel bottom, and water-worn stones in patches on the surface. The land had previously been cultivated for two years, the first crop being green maize for dairy cows, and pumpkins. The last crop prior to the potatoes was oaten hay, upon the removal of which a sowing of rape was made, and fed off by cows.

Cultivation.—The land was ploughed, harrowed twice, and rolled in the spring. It was ploughed again on 6th January, when the potatoes were planted; this was about a month later than is usual in the district. The weeds were kept under, and a light hilling up made with the horse hoe. The sets were not cut, owing to the lateness of planting, and were placed 20 inches apart in the rows, and 34 inches between the rows, and 5 inches below the surface.

Manure.—Four cwt. of potato manure was used per acre, and was strewn in the furrow with the sets.

Yields.—The average yield from the three acres was 8 tons 18 cwt. per acre. One plot, 1-10th of an acre, of Beauty of Hebron variety, yielded at the rate of 15 tons per acre; another 1-10th of an acre, Brownell's Beauty, at the rate of 13 tons; and the same area of Peach Bloom and Pinkeye at the rate of 10 tons per acre. The total percentage of small potatoes was 6 per cent. The potatoes were free from disease of any kind, and were of good shape throughout. Mr. Maconochie carefully selects his seed, taking only well-shaped, good-sized tubers for seeding purposes. He is a firm believer in large sets, and does not cut his potatoes in a dry planting season. He also holds the theory that spreading the manures on the surface encourages the growth of weeds, and for this reason he prefers placing the manure in the furrow. The whole of the crop was sold to New South Wales buyers at £6 10s. per ton, delivered at Whitfield, the return being £58 per acre gross.

T.A.J.S.

THE ORCHARD.

James Lang, Harcourt.

The most pressing work for October will be the ploughing of the orchard, and putting the ground in a good state of tilth before the advent of the dry weather. The late heavy rains have left the ground in good condition for this work, which should be pushed on as rapidly as circumstances will permit. Where peas have been sown for green manuring, they should be fit for ploughing under early this month; do not delay this too long, as the ground soon gets hard, and it is then difficult to do the work satisfactorily. Roll the peas first with a heavy roller, and, if potash manure is to be applied, sow it after rolling with muriate or sulphate of potash at the rate of 2 cwt. per acre; then plough in, using a revolving coulter to cut the peas. Do not roll any more of the peas than can be ploughed in during the day, as they rise again during the night, and they do not roll so well again.

Grafting can still be done, provided the scions are in a backward state, but it should be completed as early in the month as possible.

Citrus fruits of all kinds may now be planted out; cut them well back when planted, and do not allow them to suffer from want of water. A good mulching of strawy manure placed around the trees will keep the soil moist for a long time.

Spraying will take up a good deal of time this month, so as to keep the various pests in check. Peaches will require constant attention for the black aphis, and should curl in the leaf appear spray at once with Bordeaux mixture. Apples and pears should be attended to for black spot; the standard formula is 6.4.40 (bluestone, 6 lbs.; quicklime, 4 lbs.; water, 40 gals.), but in the drier districts the quantity of water may be increased to 50 gallons. Spraying for codlin moth towards the end of the month will also require attention. The first spraying should be given when the petals of the flower have fallen, and before the calyx has closed; this is done in order that some of the poison should be deposited in the eye of the apple, ready for any grub that may try to enter through the eye. The Kedzie soda and arsenic solution and the arsenic of lime give as good results as any of the arsenical solutions.

DISEASES OF FARM ANIMALS.

S. S. Cameron, M.R.C.V.S., Chief Veterinary Officer.

(Continued from Page 570.)

Swine Fever.

Owing to want of space, the article on "Swine Fever" has been unavoidably held over until the next issue.—Editor.